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WADC TECHNICAL REPORT 55-1
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TECHNIQUES FOR APPLICATION OF ELECTRON TUBES IN MILITARY EQUIPMENT

(This report supersedes WADC Technical Report 55-1, same title, dated October 1955)

REX S. WHITLOCK

ELECTRONIC COMPONENTS LABORATORY

OCTOBER 1957

WRIGHT AIR DEVELOPMENT CENTER

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REX S. WHITLOCK

ELECTRONIC COMPONENTS LABORATORY

OCTOBER 1957

PROJECT No. 4156

WRIGHT AIR DEVELOPMENT CENTER
AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

Carpenter Litho & Prtg. Co., Springfield, O
1400 – December 1957

FOREWORD

This report supersedes WADC Technical Report 55-1, same subject, dated October 1955, all copies of which should be destroyed.

The work was performed under Task No. 41651 of Project No. 4156, "Electronic Tubes and Transistors." Mr. Rex S. Whitlock was the responsible task engineer for the Electronic Components Laboratory, Directorate of Laboratories, Wright Air Development Center.

Acknowledgement is made to the many individuals who, although they cannot individually be identified, have assisted in the preparation of specific parts of this report, and to the personnel of Aeronautical Radio, Inc. under Joint Service Contract NObsr-64508.

ABSTRACT

This technical report presents tube information primarily from the point of view of the electronic equipment designer as a guide in the application of electron tubes. In Part I tube properties are discussed. These are grouped according to ratings, characteristics essential in circuit operation, and properties detrimental to circuit operation. Part II discusses the tube properties in relation to circuit design. It includes a check list for use of the circuit designer to insure coverage of all important design factors. Part III contains numerical data and special design considerations for specific tube types. Part IV presents product distribution curves derived from Life Test records where available. The concepts of specification control, operation within ratings, and tolerance of characteristics are emphasized throughout.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

FRED C. SCHMIDT
for
Lt. Colonel, USAF
Act. Chief, Electronic Components Laboratory
Directorate of Laboratories

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TABLE 1-1. TABLE OF SYMBOLS

For the purpose of simplification, the following abbreviations and symbols are used herein and on the tube specification sheets wherever practicable.

Å	Angstrom unit
A	Amperes (may be either ac rms or dc)
a	Amperes (peak value) or anode
Aac	ac amperes (rms)
α (alpha)	Attentuation constant
ac	Alternating current
Adc	dc amperes
ALD	Acceptance limit for sample dispersion
AQL	Acceptable quality level
β (beta)	Phase constant
B/Yo	Tuning susceptance
c	Velocity of light
C	Capacitance
°C	Degrees centigrade
cb	Centibels
Cgk, Cgp, Cpk, etc.	Tube capacitance between the electrodes indicated
Cin	Input capacitance
Ck	Capacitor between cathode and ground
CL	Load capacitance
cm	Centimeter
Cout	Output capacitance
cps	Cycles per second
CRO	Cathode ray oscilloscope
ct	Center tap
CW	Continuous wave
Δ (delta	A change in the value of the indicated variable. When expressed in percent the difference in readings is divided by the initial reading and multiplied by 100
db	Decibels
D1,2,3,4	Deflection plates
dc	Direct current
DF	Deflection factor in volts per inch
$\frac{dik}{dt}$	Rate of rise of cathode current pulse
Du	The product of time of pulse and pulse repetition rate (duty cycle)
dy	Dynode
EB	Ballistic deflection
Eb,Eb1,2,3	dc voltage on respective anodes or plates. In the case of multiplex tubes containing more than one operating unit, the number of the unit concerned is inserted between the voltage symbol and the element symbol. For example, E2b, E1p, E1c2, etc. The number of the unit is the number of the plate in that unit
eb	Peak dc anode or plate voltage
Ebb	dc anode or plate supply voltage
Eb/Ib	Adjust plate voltage to produce the specified plate current
Ec,Ec1,2,3	dc voltage on respective grids
Ecc,Ecc1,2,3	dc supply voltage to respective grids
Ec/Ib	Adjust grid voltage for the specified plate current
Eco	dc cut-off grid voltage
ed	Voltage peak between anode No. 2 and any deflection plate in cathode ray tubes
Edy	dc voltage of anode producing secondary emission
Ee	End-of-plateau voltage
Ef	Filament or heater voltage
Ef/Po	Adjust filament potential (with other potentials held constant) to reduce the power output obtained on oscillation by the amount specified
Eg1,2,3	rms value of ac component of input voltage for respective grids
egk	Peak voltage drop between grid and cathode
egy,egy1,2,3	Peak forward grid voltage.
egx	Peak inverse grid voltage
Ehk	Heater-cathode voltage (sign to indicate polarity of heater with respect to cathode)
Eid	Ignitor voltage drop
Eo	ac component of output voltage of rectifiers
EO	Overvoltage for radiation counter tubes
eo	Pulse amplitude
Ep	rms value of the ac component of plate voltage with respect to cathode
Epp	ac anode or plate supply voltage
epx	Peak plate inverse voltage
epy	Peak forward anode or plate forward voltage.
Er	Reflector voltage
ER	Reservoir voltage
Ers	Resonator voltage
Es	dc emission voltage
Es	Starting voltages for radiation counter tubes
Esd	External shield voltage
Esh	Shell voltage
Esig	Applied signal voltage
Eta	Target voltage
Etd	Average voltage drop between anode and cathode

TABLE 1-1. TABLE OF SYMBOLS (Continued)

etd	Peak voltage drop between anode and cathode
Ez	Ionization, breakdown, or striking voltage
f	Filament
F	Frequency (in cps)
FA	Maximum frequency above which receiving tube performance deteriorates seriously and sharply
F1	Maximum frequency at which maximum ratings apply
F2	Frequency at which maximum plate voltages and plate input are limited to 50 percent of the ratings for F1. For frequencies between F1 and F2 the maximum plate voltage and plate input will be reduced in the correct proportion so that at the frequency F2 these factors will not exceed 50 percent of their maximum ratings
fct	Filament center tap
fk	Filament-cathode return
Fsg	Frequency of signal generator
ft. L.	Foot lamberts
G	Acceleration of gravity
G Yo	Equivalent conductance
γ (gamma)	Propagation constant
g, g1,2,3	Grid (number to identify grids, starting from cathode)
g2 + 4	Grids having common pin connection
GA	Gas amplification
Gr	Gas ratio
H	Field strength in gauss
hct	Heater center tap
ht	Heater tap
Ia	Anode current
Ib, Ib1,2,3	dc current of respective anodes or plates
ib	Peak value of dc anode or plate current. When used in reference to pulses, the maximum peak current excluding spike
Ic, Ic1,2,3	dc current of respective grid
ic	Peak grid current
Idy	Current of anode producing secondary emission
If	Filament or heater current
if	Intermediate frequency
Ig	rms value of ac component of grid current
Ihk	Heater-cathode leakage current
Ii	Ignitor current
Ik	dc cathode current
ik	Peak cathode current
iL	Peak load current
int con.	Internal connection
Io	dc component of output current of rectifiers per tube
Ip	rms value of ac component of plate current
Ir	Reflector current
IR	Reservoir current
Irs	Resonator current
Is	dc emission current
is	Peak emission current
Isg	dc component of primary emission from grid indicated
Ita	dc target current
Iz	Ionization current
K	Degrees Kelvin
k	Cathode
kc	kilocycles
kMc	Kilo-megacycles
KTB	Theoretical resistance noise power
kv	Peak kilovolts
kVA	Kilovolt-amperes
kva	Peak kilovolt-amperes
kVac	ac kilovolts (rms)
kVdc	dc kilovolts
kW	Kilowatts
kw	Peak kilowatts
L	Lamberts
LAL	Lower acceptance limit for sample average or sample median
λ (lambda)	Wavelength
λo	Resonant wavelength
Lc	Conversion loss or gain (ratio of available signal power to the available intermediate frequency power)
LIb	Leakage current
Li	Insertion loss
lm	Lumens
LRLM	Lower reject limit median for a sample of tubes
LS1	Standardized light source supplied by a coiled tungsten lamp with a lead or lime glass envelope operated at a color temperature of 2,870°K
LSLA	Lower specification limit for average of acceptable lots
M	Figure of merit, or one million
m	Meter, or one-thousandth
mA	ac (rms) or dc milliamperes
ma	Peak milliamperes
mAac	ac milliamperes (rms)
mAdc	dc milliamperes
Mc	Megacycles
Meg	Megohms
mftL	Millifoot lamberts
mH	Millihenry
mL	Millilamberts
mr	Milliroentgen
MRSD	Maximum rated standard deviation
ms	Milliseconds
Mu or u	Amplification factor
mVac	ac millivolts (rms)
mVdc	dc millivolts
mv	Peak millivolts
MW	Megawatts
Mw	Peak megawatts
mW	Milliwatts
mw	Peak milliwatts
N	Counts for radiation counter tubes

TABLE 1-1. TABLE OF SYMBOLS (Continued)

nc	No connection
NF	Noise figure
Npm	Counts per minute
Nps	Counts per second
Nr	Output noise ratio (ratio of noise power output to resistance noise power)
p	Plate
/p	Per plate
Pb	Plate breakdown factor (epx x prr x Ib)
Pd	Average drive power
pd	Peak drive power
Pg1,2,3	Power dissipation of respective grids
Pi	Power input (plate)
pi	Peak power input
Pj	Reactive power in watts
Pl	Plateau length
Pn	Noise output
P'o	Intrinsic P
Po	Average power output
Po / Du	Peak leakage power
ΔPo, etc / Ef	Change in Po, etc. of an individual tube, caused by the specified change in Ef
ΔPo, etc / t	Change in Po, etc. caused by a test (life, shock, fatigue, etc.)
po	Peak power output
Pp	Plate or anode power dissipation
prr	Pulse recurrence rate in pulses per second
Ps	Relative plateau slope
Q	Quality of a circuit
QL	Loaded Q
Qo	Intrinsic Q or quality of a circuit without external loading
r	Reflector
r	Roentgen
R	Resistance
Rb	dc resistance of external plate circuit (by-passed)
Rc	dc resistance of external grid circuit (by-passed)
Rc	Reference resistor for noise ratio measurements (for crystal rectifiers)
rf	Radio frequency
Rf	Resistance in series with filament or heater
Rg	Resistance in series with grid
rg	Dynamic internal grid resistance
Rk	Resistance in series with cathode
Rka1, Rka2, Rkrs, Rfrs, etc.	Tube resistance between the electrodes indicated
RL	Load resistance (Unity power factor. Negligible dc resistance.)
rms	Root mean square
Rp	Resistance in series with plate or anode
rp	Dynamic internal plate resistance of tube
rs	Resonator
Rv	Video impedance
S	Static sensitivity (phototubes)
s	Dynamic sensitivity (phototubes)
se	Starter electrode
Sc	Conversion transconductance
Sd	Spectral distribution
sd	Shield
Sg1, g2, etc.	Transconductance between the elements indicated
sh	Shell
σ (sigma)	"Input" standing-wave ratio in voltage
σ' (sigma prime)	"Output" standing-wave ratio in voltage
Sm	Transconductance (control grid-plate)
ΔSm, etc. / Ef	Change in Sm, etc. of an individual tube, caused by the specified change in Ef
ΔSm, etc. / t	Change in Sm, etc. caused by a test (life, shock, fatigue, etc.)
Sr	Sensitivity ratio (max. Ib to min. Ib)
T	Temperature (degrees centigrade)
t	Test duration (seconds, unless otherwise specified)
TA	Ambient temperature
ta	Target
tad	Anode delay time. A time interval between the point on the rising portion of the grid pulse which is 26 percent of the maximum unloaded pulse amplitude and the point where anode conduction takes place
Δtad	Anode delay time drift
TE	Envelope temperature
tf	Time of fall. The time duration of pulse to fall from 70 7 percent of the maximum pulse amplitude to 26 percent of the maximum pulse amplitude, excluding spike, in microseconds
THg	Temperature of condensed mercury in °C
tj	Variation in firing time
tk	Cathode conditioning time (in seconds) necessary before the application of high voltage. In TR tubes, time delay between application of ignitor voltage and rf power
tp	Pulse duration (excluding magnetrons). The time interval between the points on the trace envelope at which the instantaneous amplitudes are equal to 70.7 percent the maximum amplitude excluding spike. For magnetrons, see 4.16.3.3

TABLE 1-1. TABLE OF SYMBOLS (Continued)

tr	Time constant of rise (excluding magnetrons). The time duration of a pulse to rise from 26 percent of the maximum pulse amplitude to 70.7 percent of the maximum pulse amplitude, excluding spike, in microseconds
trc	Time of rise of current pulse in microseconds (for magnetrons, see 4.16.3.3)
trv	Time of rise of voltage pulse in microseconds (for magnetrons, see 4.16.3.3)
µ	Amplification factor
ua	Microamperes, peak value
uAac	ac microamperes (rms)
uAdc	dc microamperes
UAL	Upper acceptance limit for sample average or sample median
umhos	Micromhos
uf	Microfarads
uh	Mic[illegible]nries
URLM	Upper reject limit median of a sample of tubes
us	Microseconds
USLA	Upper specification limit for averages of acceptable lots
uuf	Micromicrofarads
uVac	ac microvolts (rms)
uVdc	dc microvolts
uW	Microwatts
V	Volts (may be either ac rms or dc)
v	Volts, peak value
VA	Volt-amperes
va	Peak volt-amperes
Vac	ac volts (rms)
Vdc	dc volts
v/in	Volts, peak value, per inch of deflection
Vj	Amplitude jitter
VSWR	Voltage standing wave ratio
VU	Volume units
Vx	Extinguishing voltage
W	Watts
w	Peak watts
Ws	Spike leakage energy
X1	The orientation of a tube rigidly mounted for mechanical tests with the main axis of the tube and the major cross-section of the tube elements normal to the direction of the accelerating force
X2	The orientation of a tube rigidly mounted for mechanical tests with the main axis of the tube normal and the major cross-section parallel to the accelerating force
x	Denoting peak inverse value
Y1	The orientation of a tube rigidly mounted for mechanical tests with the main axis of the tube parallel to the direction of the accelerating force. (When Y1 is referred to for shock tests, the principal base of the tube is toward the hammer)
Y2	The orientation of a tube (for shock test only) which is the same as Y1 except that the principal base of the tube is away from the hammer
y	Denoting peak forward value
Z	Impedance
Zd	Impedance to anode of deflection plate circuit at power-supply impedance
Zg	Impedance of the grid circuit
Zgg	Impedance between grids of push-pull circuit
Zgk	Impedance between grid and cathode
Zi	Input impedance
Zl	Load reactance ([illegible] a negligible dc resistance)
Zm	Modulator frequency load impedance
Zo	Output impedance and characteristic impedance
Zp	Impedance in plate circuit
Zpp	Impedance between plates in push-pull circuit
1D2	Deflection produced by the deflection plates near the screen (for cathode-ray tubes)
3D4	Deflection produced by the deflection plates near the base (for cathode-ray tubes)
••	Qualification test
•	Standard design test
#	Special design test
+	Test to be performed at the conclusion of the holding period (See 4.5)
←	Indicates change on tube specification sheet
←o	Indicates deletion from the tube specification sheet

TECHNIQUES FOR APPLICATION OF ELECTRON TUBES IN MILITARY EQUIPMENT

INTRODUCTION

The objective of this report is to provide an aid to design engineers of military equipment in the application of electron tubes.

The complexity of military aircraft has become such that the misapplication of a single part can nullify the aircraft's effectiveness. The variability of the electron tube, as a manufactured product, has often gone unrecognized because certain information about the properties of electron tubes has not been available. Failure to appreciate the significance of this variability as a design factor has many times resulted in failure to realize operational reliability.

It is evident that more than the electron tube-equipment relationship influences reliability. Contributing factors fall into several areas, such as military requirements, equipment production, environments in which used, manner in which used, and maintenance and supply practices. This report confines itself to a consideration of electronic equipment design as it is influenced by electron tube procurement specifications. Every effort has been made to present the information constructively, factually, and in a manner which makes its value apparent without detailed study.

The contents of this report conform to the latest issue of Military Standard, MIL-STD-200C, with application information on 52 tube types. Eventually, all receiving electron tube types covered by MIL-STD-200 are to be included in this manual.

Part I, of this report, discusses the properties common to all electron tubes. Part II considers the effect of these properties in circuit design. Part III presents a summary of application information with reference to specific structural or functional categories of tubes. This is followed by mechanical, electrical, and environmental information on specific tube types together with any application notes which are uniquely applicable to specific tube types. Part IV outlines observed property behavior on specific tube types.

This report is to serve as a guide which should be followed with discretion and tempered in application by good engineering judgment. Facts, data, and advice are presented which are not elsewhere available in consolidated form.

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TABLE 1-2. TUBE PROPERTIES

TUBE PROPERTIES FREQUENTLY DEFINED IN SPECIFICATIONS		
Ratings	**Characteristics**	**Detrimental Properties**
Heater Voltage Anode Voltage (dc) Screen Grid Voltage (dc) Heater-Cathode Voltage Anode Dissipation Screen Grid Dissipation Output Current (Rectifiers) Output Voltage (Rectifiers) Peak Current (Rectifiers) Peak Inverse Voltage (Rectifiers) High Impact Shock	Transconductance Plate Current Screen Grid Current Heater Current Inter-Electrode Capacitance Amplification Factor Power Output Emission Conversion Conductance	Control Grid Current at Rated E_f Heater-Cathode Leakage Microphonics Noise Shorts and Continuity Vibration Output
TUBE PROPERTIES OCCASIONALLY DEFINED IN SPECIFICATIONS		
Ratings	**Characteristics**	**Detrimental Properties**
Anode Voltage--Peak Forward Anode Voltage--Peak Inverse Control Grid Voltage Control Grid Resistance Average Cathode Current Bulb Temperature Pressure	Dynamic Plate Resistance Bias For Plate Current Cutoff	Electrode Insulation Grid Current at Elevated E_f Change of Characteristics with Life Change of Characteristics with E_f
TUBE PROPERTIES RARELY DEFINED IN SPECIFICATIONS		
Ratings	**Characteristics**	**Detrimental Properties**
Peak-Pulse-Cathode Current	Zero Bias Plate Current Zero Bias Screen Current Plate Current at Multiple Bias Points Screen Current at Multiple Bias Points	Initial-Velocity Electron Current (Contact Potential) Electron Coupling Effects Plate Emission Screen Emission

PART I

TUBE PROPERTIES

1. CATEGORIES OF TUBE PROPERTIES.

1.01 The electronic equipment designer may best visualize the ability of a specific tube type to satisfy a given circuit requirement by grouping its properties in five separate categories as follows:

1.02 RATINGS. The set of limiting values defining each individual operating condition within which the tube type can be expected to yield a nominal period of satisfactory service.

1.03 CONTROLLED CHARACTERISTICS. Properties of the tube essential to the operation of the circuit which are confined within distinct ranges of values, defined for a given type number by specification.

1.04 UNCONTROLLED CHARACTERISTICS. Properties of the tube essential to the operation of the circuit, but of indeterminate range of values owing to lack of definition within the specification.

1.05 CONTROLLED DETRIMENTS. Inherent tube properties which must be considered in circuit design on the basis of their detrimental effects upon circuit operation. They have no specified distribution of values, but instead are restricted by a single specification limit upon the magnitude or frequency of occurrence of the property.

1.06 UNCONTROLLED DETRIMENTS. Inherent tube properties detrimental to circuit operation, which are not defined in the specification and, therefore, can be considered only in a qualitative manner.

1.07 Since some characteristics and detriments will be restrictively defined for one tube type, but not for another, both controlled and uncontrolled properties are treated in this handbook under their respective titles -- Characteristics and Detrimental Properties. Table 1-2 gives an indication of the general tendency toward the specification of these properties.

SECTION 1

RATINGS

1.1 TUBE RATINGS AS LIMITING VALUES.

1.1.1 Tube ratings are the set of limiting values defining conditions of operation within which the tube type can be expected to yield a nominal period of satisfactory

service. Two systems are used in designating these values: the absolute maximum system and the design center system. Although military specifications make use of the absolute maximum system of ratings, the designer must occasionally utilize a type for which a military specification has not been effected, so he should be able to use either system.

1.1.2 THE DESIGN CENTER SYSTEM. The design center maximum system was conceived to control the use of tubes in relatively simple circuits. Due to the complex and critical nature of many present-day circuits, this system is no longer adequate. The design center maximum ratings allow for a 10% rise over rated values due to limited variations in operating conditions. This is not always sufficient for modern equipment and the stringent operating conditions imposed. In addition, no allowance is made for variations in tube characteristics. This may cause inadvertant tube abuse should the calculated operating condition be near a rated value. To properly use this system, design ratings must be specified sufficiently below the design center maximum rating to allow for these variations. For these reasons, military specifications do not use this system.

1.1.3 THE ABSOLUTE MAXIMUM SYSTEM. In the absolute maximum system, the rated values must not be exceeded for any tube which conforms to the given specification under any specified condition of supply voltage variation, ambient temperature change, tube or other circuit component manufacturing variation, equipment control adjustment or any combination thereof. The equipment designer has the responsibility of determining design values for each rating such that the absolute maximum value of that rating will not be exceeded under any combination of anticipated variations. These design ratings must take into account the normal variation in tube characteristics and allow for the severest possible condition of signal voltage.

1.1.4 Although ratings are specified by single-valued limits, they cannot be considered as absolute barriers on one side of which satisfactory operation can continue indefinitely, while on the other side, almost immediate degradation will occur. The equipment design engineer must realize that the expected period of satisfactory operation decreases in a continuous manner as the rating is approached. Exceeding the rating continues this decline. Therefore, the more conservative the use of the tube with respect to these ratings, the greater the life expectancy of the tube. The numerical value specified is usually the value which assures acceptable results under specified life-test conditions and is not necessarily related to any particular usage. Table 1-3 summarizes the effects and the types of tube failure which may follow an approach to the common tube ratings.

TABLE 1-3. APPROACHING COMMON TUBE RATINGS

APPROACHING THIS RATING → MAY CAUSE	RESULTING IN	Max Anode or Screen Voltage	Max Peak Forward Anode Voltage	Max Positive Control Grid Voltage	Max Negative Control Grid Voltage	Max Heater Voltage	Min Heater Voltage	Max Control Grid Return Resistance	Max Anode or Screen Dissipation	Max Heater Cathode Voltage	Max Cathode Current	Min Cathode Current	Max Output Current for Rectifiers	Max Output Voltage for Rectifiers	Max Inverse Voltage for Rectifiers	Max Bulb Temperature
Increased Operating Temperature of Tube Elements	Accelerated Evolution of Gas (Positive Shifts in Bias and Progressive Loss of Emission)			x		x			x		x		x			x
	Thermal Expansion of Tube Parts (Shorts and Temporary Change of Characteristics)					x			x							x
	Accelerated Formation of Leakage Paths					x										
	Cracks in the Glass Envelope					x			x				x			x
	Increased Contact Potential					x										
	Shortened Heater Life					x										
Increased Potential Gradient	Voltage Breakdown of Insulation		x		x					x				x	x	
	Increased Rate of Heater Cathode Shorts					x				x						
Increased Temperature of Elements and/or Potential Gradient	Increased Effects of Control Grid Emission (Shifts Bias More Positive)			x		x		x	x							x
	Increased Effects of Anode Emission (Arc-Back in Rectifiers or Positive Bias Shift in Amplifiers)		x			x		x	x				x	x	x	x
	Increased Heater-Cathode Leakage					x				x						
	Accelerated Formation of Cathode-Interface Resistance				x	x						x				
	Accelerated Electrolysis Effects (Glass Leakage Current and Possible Loss of Vacuum)	x	x			x			x				x	x	x	x
Accelerated Change in Characteristics With Time		x			x	x			x		x	x	x			x
Increased Initial Variation in Characteristics from Tube to Tube				x		x	x				x	x				
Inadvertently Exceeding Other Ratings		x	x	x	x	x		x	x		x		x	x	x	x

SECTION 2

CHARACTERISTICS ESSENTIAL TO CIRCUIT OPERATION

1.2 VARIATION AND CONTROL OF TUBE CHARACTERISTICS.

1.2.1 Controlled characteristics are properties of the tube essential to the operation of the circuit. They exist within a distinct range of values, defined for a given type number by specification. Variation is inherent to all manufactured products. The receiving tube is no exception to this rule. Unfortunately, engineering text books have generally neglected tube variations in discussing circuit design and the use of tube characteristics. In general, the published technical data which describe and define electron tubes present only the center values of the product. Consequently, the fact that the families of characteristic curves describe typical or representative tubes and that many individual specimens will be found which depart appreciably from this typical representation is frequently overlooked.

1.2.2 NORMAL DISTRIBUTIONS.

1.2.3 With respect to most tube characteristics the frequency with which individual tubes appear for a given tube type tends to follow the familiar normal probability curve shown in Figure 1-1. In this curve, the relative frequency of occurrence of a particular reading is plotted against the individual values of the characteristic under test. Such a normal distribution curve is uniquely defined by specifying the average value of the tube characteristic ($\bar{X}$) and a factor (σ) which is a measure of

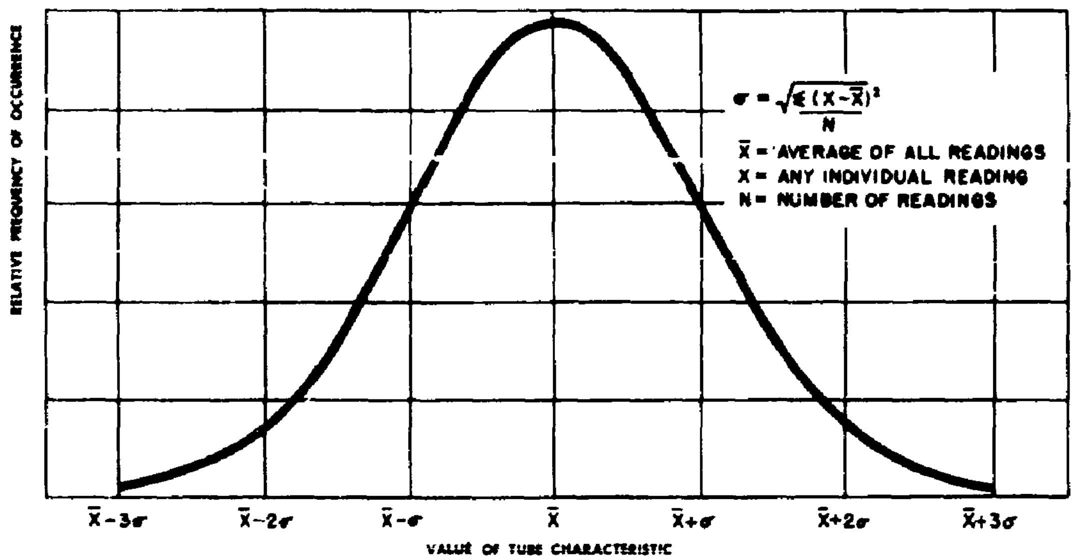


Figure 1-1. Distribution Curve for a "Normal" Tube Characteristic

the spread of the tube characteristic distribution about the average value. The factor (σ) is such that for the normal curve roughly 68% of the tubes considered have characteristic values falling between $\bar{x} + \sigma$, and $\bar{x} - \sigma$. Approximately 95% of the tubes have values between $\bar{x} + 2\sigma$ and $\bar{x} - 2\sigma$, and 99.7% between $\bar{x} + 3\sigma$ and $\bar{x} - 3\sigma$.

1.2.4 SKEWED DISTRIBUTIONS.

1.2.5 Some tube characteristics and most tube detriments are not normally distributed. Notable examples are characteristics such as plate-current cutoff, power output and screen current, and detriments such as heater-cathode leakage and gas current. In these cases the associated distribution curves are not symmetrical about the mean and are said to be skewed. Figure 1-2 shows a typical skewed distribution for the plate-current cutoff characteristic. Many tube characteristics which, on a long term basis, tend toward "normal" distributions, may on a lot-by-lot basis display distributions which depart materially from "normal" in cases where permissible dispersion is not specified.

1.2.6 PRODUCT AND LOT DISTRIBUTIONS.

1.2.7 When the variations in one characteristic of a tube type over a long period of time are plotted, the resulting graph becomes a "Product Distribution Curve", such a curve being the sum of many "Lot Distribution Curves". A typical relationship

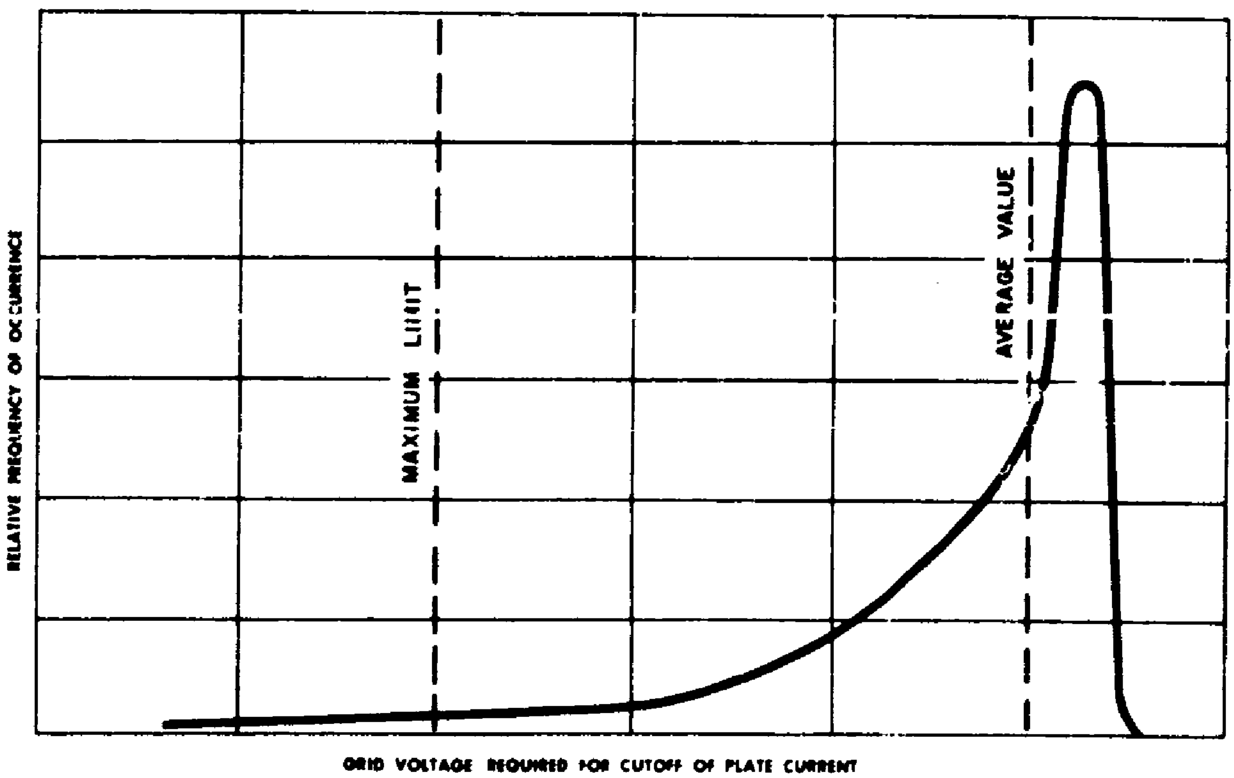


Figure 1-2. A Typical Skewed Distribution Curve

TABLE 1-4

COMBINATIONS DEFINING LOT DISTRIBUTIONS OF TUBE CHARACTERISTICS VS. PROCUREMENT SPECIFICATIONS

Limits of Specification	Controls on "Lot" Basis
Min--Max	Minimum and maximum values only
Min--LRLM--URLM--Max	Minimum and maximum values and sample median
Min--LAL--UAL--Max, ALD	Minimum and maximum values, sample average($\bar{x}$) and sample dispersion

LRLM = Lower reject limit for sample median

URLM = Upper reject limit for sample median

ALD = Acceptable limit for the dispersion (weighted σ)

LAL = Lower limit for the sample average ($\bar{x}$)

UAL = Upper limit for the sample average ($\bar{x}$)

between these curves is illustrated in Figure 1-3. Although tube specifications and published technical data are based on the "Product Distribution Curve", tubes are in general procured and used on a lot-by-lot basis. Considerable difference may exist between "lot" and "product" distributions depending upon the nature of the procurement specification. Table 1-4 lists some common combinations used to define "lot" distributions of tube characteristics in procurement specifications. The term "ALD" is the parameter σ weighted for the sample size used in the test.

1.2.8 It is apparent that the "Min--Max" system of limits in no way defines the distribution of characteristics but only restricts the individuals to a defined range. The "Min--LRLM--URLM--Max" system is better in that it restricts the median of each sample to a defined range, but widely dispersed or multimodal (many peaked) distributions may still exist in this system even though their medians are within the "LRLM--URLM" range. The use of "Acceptable Lot Dispersion" (ALD) to form the "Min--LAL--UAL--Max, ALD" system defines the range, sample average and the dispersion of the individual sample. An alternate system is "LRLM--URLM with less than 50% of the measurements of the sample outside those limits". Despite these systems, considerable difference still may exist between the "Lot Distribution" and "Product Distribution".

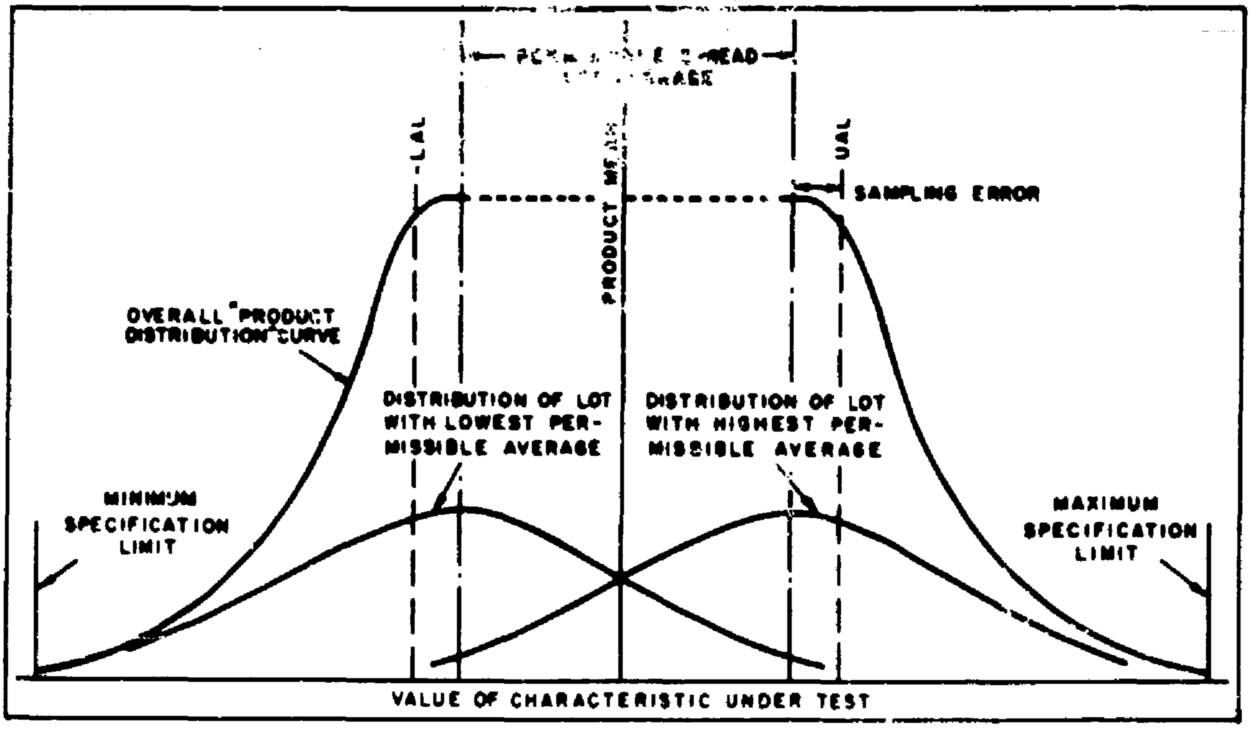


Figure 1-3. Example of "Normal" Distribution of a Given Tube Characteristic "Product Distribution" Curve and "Lot Distribution" Curve

SECTION 3

PROPERTIES DETRIMENTAL TO CIRCUIT OPERATION

1.3 GENERAL.

1.3.1 Detriments are inherent tube properties which must be considered in circuit design on the basis of their adverse effects upon circuit operation. They have no specified range of values, but instead are restricted by a single specification limit upon the magnitude or frequency of occurrence of the property. Certain of these detriments become apparent upon initial installation of the tube; others become evident only through equipment malfunction with the passage of time.

1.3.2 In order that maximum utilization of the Essential Characteristics can be realized, it is necessary that these undesired properties be recognized as potential contributors to equipment failure. There are three courses which the equipment design engineer can follow to reduce the probability of equipment malfunction resulting from these detrimental properties:

a. Select a tube type for which the specification quantitatively defines the undesired property of the tube.

b. Avoid operating the tube under conditions which will aggravate the effect or accelerate its development.

c. Design the circuit to tolerate the presence of the undesired properties both initially and after extended operation.

1.3.3 The following material reviews briefly the source and nature of some generally unrecognized but often unrecognized properties of present-day electron tubes, the variables involved and their effects upon the circuit and its operation, methods of reducing the effects of the undesired characteristics, and, where known, methods of testing for and simulating the presence of these properties.

1.3.4 INITIAL-VELOCITY GRID CURRENT.

1.3.5 Figure 1-4 demonstrates a typical relationship between control grid current and the grid cathode potential difference resulting from the initial velocity of electrons emitted from the cathode. The value of grid potential producing a current of 0.1 microampere is arbitrarily called the "Contact Potential" of the tube. The curve of grid current vs grid-cathode potential may be considered as a plot of the number of electrons emitted per unit time (grid current) having sufficient kinetic energy to move to the grid against a given retarding electrical field. (The retarding field must be considered as the actual potential between the surface of the cathode and the surface of the control grid. This includes the external bias as well as the "thermal-contact-difference of potential" of dissimilar materials in the grid-cathode circuit loop.) The resulting current is consequently a function of grid-cathode potential, and cathode temperature, as well as composition and area.

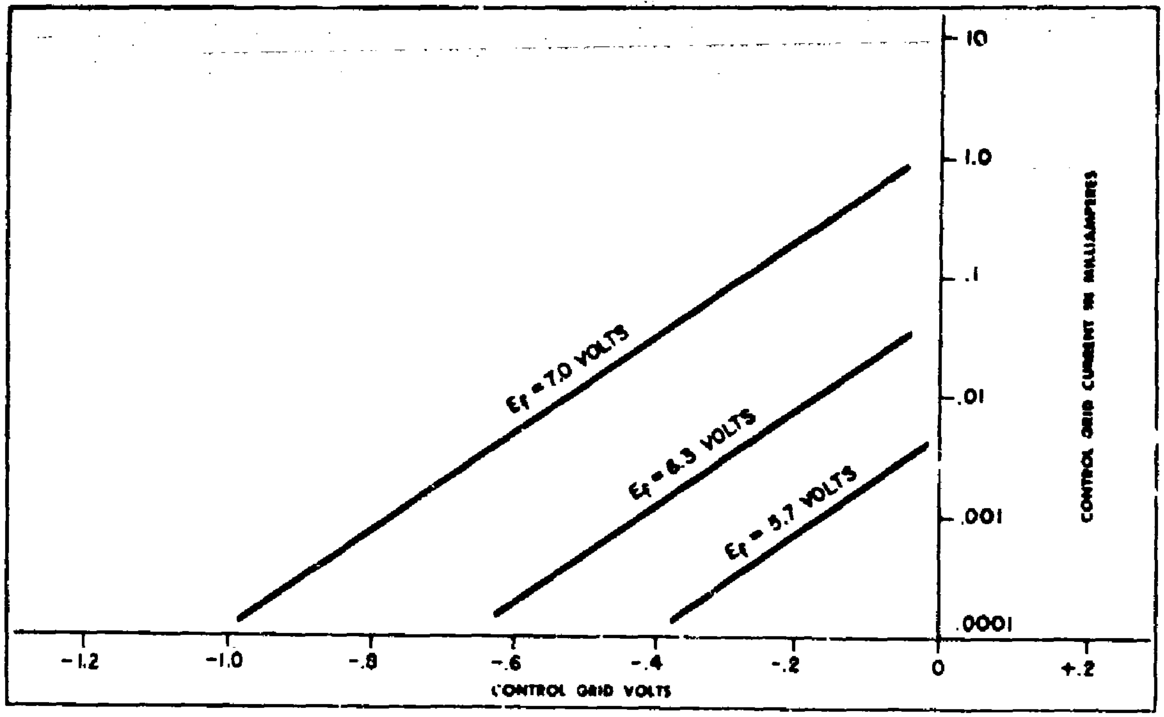


Figure 1-4 Typical Variation of Initial Velocity Grid Current with Heater Voltage and Grid Potential

1.3.6 The cathode area will be reasonably similar in tubes of the same type. Cathode temperature is usually dependent upon the operating heater voltage. Hence, variations of initial-velocity electron current will occur in a particular tube type primarily with changes in heater voltage, also from tube to tube, and particularly among tubes of different manufacture.

1.3.7 To the circuit designer the effect of initial-velocity grid current is twofold in the grid potential range between zero and approximately -1.3 volts. First, it represents a finite dynamic grid impedance with magnitude dependent upon grid potential. Second, it represents a direct current source having high internal resistance with the negative pole on the grid and positive pole on the cathode. In the first case, the effect may appear as the loading of tuned input circuits, or cause extreme distortion at low frequencies in audio amplifiers. In the second case, it may, where the major portion of grid return resistance is common to several grids, cause variations of AGC or AVC bias, since the tube having the most negative "Contact Potential" will determine the residual bias under no-signal conditions and thereby the maximum sensitivity.

1.3.8 The dynamic impedance and d-c biasing effects may be reduced by the use of the minimum grid return resistance compatible with circuit function and establishment of cathode or fixed bias sufficient to remove the grid operating potentials from the region of initial-velocity current effects. Usually 1.3 volts bias will suffice. Although excessive heater voltage will greatly increase the magnitude of the current,

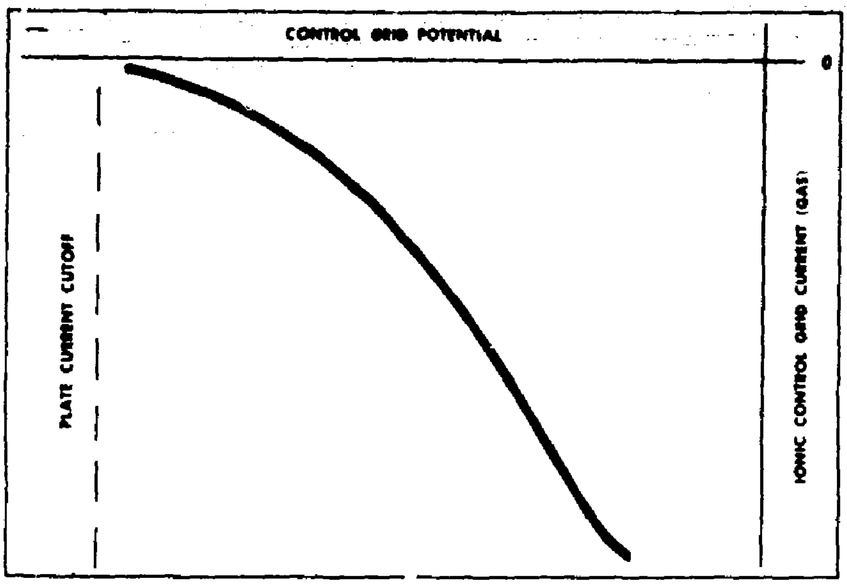


Figure 1-5. Typical Variation of Ionic Grid Current with Grid Potential

sublimated from the cathode sleeve condense on relatively cool surfaces such as the mica spacers. Such leakage paths usually have a resistance that decreases as the applied voltage increases. In addition, the resistance value of such a path is quite variable as the path may intermittently open and close due to loose electrical connection with the electrode.

1.3.16 Resistance values between grid or plate and all other elements due to internal leakage lower than 5 megohms at 300 volts may be observed while a normal tube usually measures more than 5000 megohms. Under humid conditions, leakage paths may appear between pins outside the tube envelope having resistance values less than 10 megohms.

1.3.17 Since high heater voltage and excessive bulb temperature accelerate the formation of internal leakage, the design engineer can reduce the incidence of these effects by control of thermal and electrical operating conditions and particularly by the use of tube types having specifications defining insulation resistance on life test.

1.3.18 SPURIOUS EMISSION CURRENTS.

1.3.19 Most electrodes of a tube are capable of some emission current during operation. The magnitudes of such currents depend almost entirely upon the electrode temperatures. In most applications, the major concern is with currents originating at the control grid as primary or secondary emission to some more positive element. In this case, a positive shift in bias occurs dependent upon the value of the grid-return resistance. This effect, like ionic grid current, is capable of compounding into a condition where loss of plate current control results, provided sufficient grid-return resistance exists.

1.3.20 In applications where the control grid is not maintained as the most negative tube element, the grid may act as an anode and receive emission currents from other elements causing a negative shift in bias. This effect frequently occurs in circuits which utilize alternating current supplies for the plate or screen. It is generally characterized by a gradual negative drift in bias requiring several minutes after warm-up to reach a quasi-stable state. In addition to short term variations during warm-up, any of the spurious emission currents may show a long term increase throughout the life of the tube.

1.3.21 Spurious emission currents display wide variations in magnitude from tube to tube and under different operating conditions. Current at the control grid higher than 10 microamperes may be experienced in some tubes.

1.3.22 Reduced operating temperatures and low values of grid resistance will help to reduce these effects, particularly avoidance of increased grid temperature from heat produced by excessive heater voltage. Some tube specifications employ grid current tests at elevated heater voltage to insure a reduced tendency for development of primary control grid emission. Specification of screen grid and plate emission is comparatively rare.

1.3.23 NET EFFECTS OF CONTROL GRID CURRENT.

1.3.24 Under direct current or low frequency operation, undesired currents may flow in the control grid circuit from at least four different sources within the tube. They are as follows:

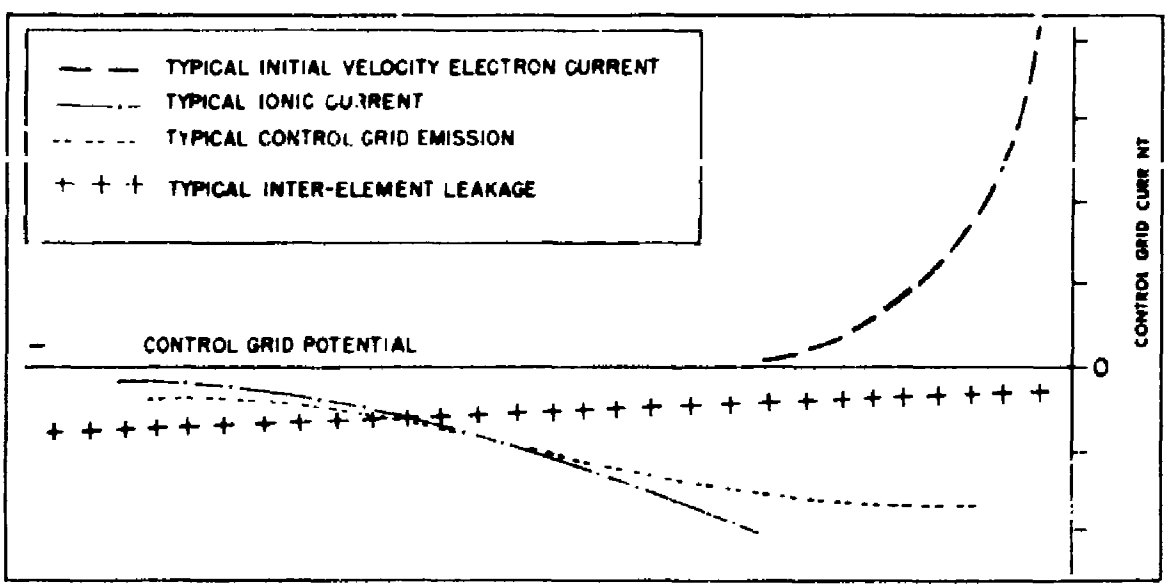


Figure 1-6. Comparison of Control Grid Current Sources

a. Electrons of high initial velocity.
b. Ions formed by collision.
c. Interelement conductive paths (surface leakage).
d. Undesired electron emission (from elements other than the cathode).

1.3.25 A comparison of these four sources is shown in Figure 1-6. It is obvious that in different tubes the net grid current may differ widely depending upon the magnitude of each individual current. This figure is intended to show the trend in current-voltage characteristics of the control grid as a circuit element apart from its ability to control plate current.

1.3.26 Two characteristics of the control grid become apparent; first, it is capable of finite dynamic impedance in the negative bias region; second, it is capable of shifting the externally applied bias by means of internal conduction paths and emission sources.

1.3.27 Two preventive methods are common to all four of the mentioned current sources; first, reduction of the operating temperature of the control grid, particularly by the avoidance of heat produced through excessive heater voltage; second, the use of grid return resistance of the smallest value compatible with circuit function and in no case greater than the maximum rated value.

1.3.28 CROSS CURRENTS.

1.3.29 In multistructure tubes the anodes are often perforated at one or more points by apertures which remain open after the tube is assembled. In the completed tube such open windows may look directly at another supposedly independent structure. Through such windows, cross currents can flow from the cathode of one structure to the anode, side rods, etc., of the other, forming a coupling path between apparently independent circuits. Such currents also lead to a condition which precludes the complete cutoff of one or more sections regardless of grid voltage. Where the equipment design engineer uses multistructure tubes in circuits critical to cross currents, he should assure himself that the tube specification adequately defines cutoff both in method of test and limit value. His only alternative is to design the circuit to tolerate cross currents.

1.3.30 HEATER-CATHODE LEAKAGE.

1.3.31 In most tubes that utilize indirectly heated cathodes, the heater is coated with or enclosed within a ceramic material to electrically insulate it from the cathode. During operation, the insulating value of the ceramic may decrease permitting current to flow between heater and cathode. The precise mechanism of heater-cathode leakage is complex and at best only hypothetically explained. Suffice it to say that the current usually increases greatly with an increase in heater temperature and that with a d-c voltage applied between heater and cathode the current-voltage relationship generally is non-linear in the low-voltage region. Figure 1-7 illustrates a typical current-voltage relationship.

1.3.32 When alternating voltages are applied, peak currents may be drawn that are greater than those measured for corresponding values of direct voltage. This often

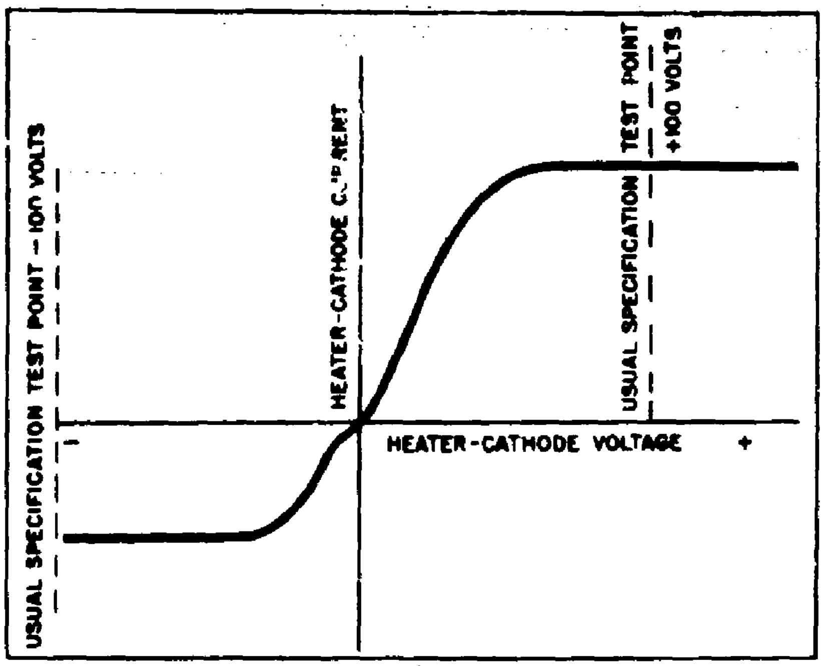


Figure 1-7. Typical Heater-Cathode Voltage and Current Relationship Indicating the Location of the Usual Specification Test Points

results in leakage currents of high harmonic content when sine-wave voltages exist between heater and cathode. This also implies that correlation is usually difficult between d-c testing and a-c operation. To aggravate the situation, leakage measurements on a given tube may vary somewhat from reading to reading.

1.3.33 The most common circuit difficulty which arises from heater-cathode leakage is the introduction of an extraneous signal from the heater into the input circuit of the tube. The signal voltage is formed at the cathode by the passage of leakage current through the cathode resistor. A voltage may also be coupled from the heater to the input through the physical capacitance between heater and cathode. This consideration becomes quite important if operation or test occurs at more than one a-c heater supply frequency. The reactance of this capacitive coupling at 400 cycles will be less than 1/6 of the reactance at 60 cycles and the coupled voltage will be higher at the higher frequency.

1.3.34 Heater-cathode leakage current is usually measured for tube-testing purposes at both plus and minus 100 volts on the heater with respect to the cathode, the higher current reading being recorded. As of this date, initial specification limits range from 2 to 100 microamperes, while typical life-test end point values range from 10 to 120 microamperes.

1.3.35 The effects of heater-cathode leakage may be reduced by avoiding excessive heater voltage and by using the lowest value of cathode resistance compatible with circuit function.

1.3.36 A typical relationship between heater-cathode defectives and applied heater-cathode potential is shown in Figure 1-8. This curve includes tubes failing to pass specification because of excessive heater-cathode leakage or indicated shorts between heater and cathode.

1.3.37 THERMIONIC INSTABILITY.

1.3.38 Most existing knowledge concerning thermionic instability of tubes is in the observed phenomena rather than the established theory state. It has been observed that in general: (1) the apparent emission capabilities of cathodes decline during life; (2) the range of emission capabilities of the tubes in a given lot may increase during life; (3) the variation of emission capabilities with heater voltage increases during life. Plate current is used as an illustration in Figure 1-9.

1.3.39 In addition to long-term changes, observations indicate that an operating cathode may undergo a short-term readjustment of characteristics if the average cathode-current level is changed from an established operating value. This short-term readjustment may start as a result of abrupt changes in the operating conditions of the circuit, or even initially upon installation of a new tube. Some specifications incorporate requirements on the stability of individual tubes in terms of the stability of their characteristics during the first hour of life test. To have significance, the test must be based upon the stability of individual tubes rather than the sample average.

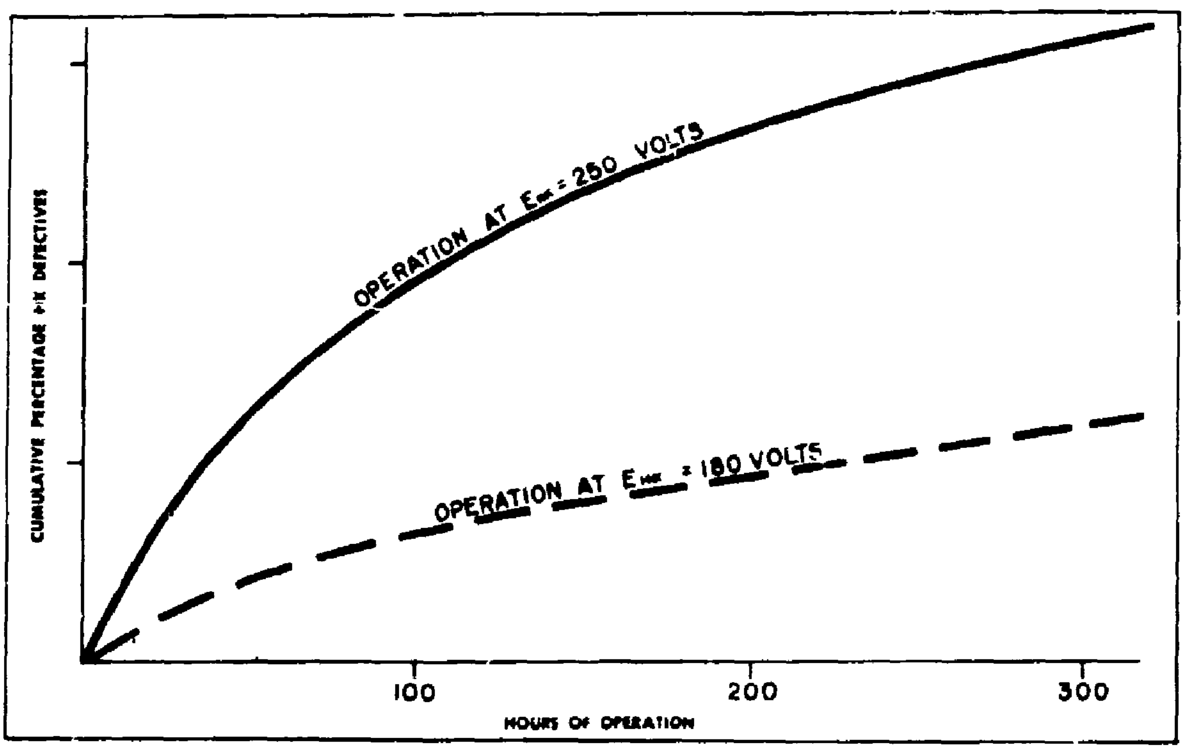


Figure 1-8. Typical Heater-Cathode Defectives on Static Life Test Illustrating Effect of Excessive Heater-Cathode Voltage

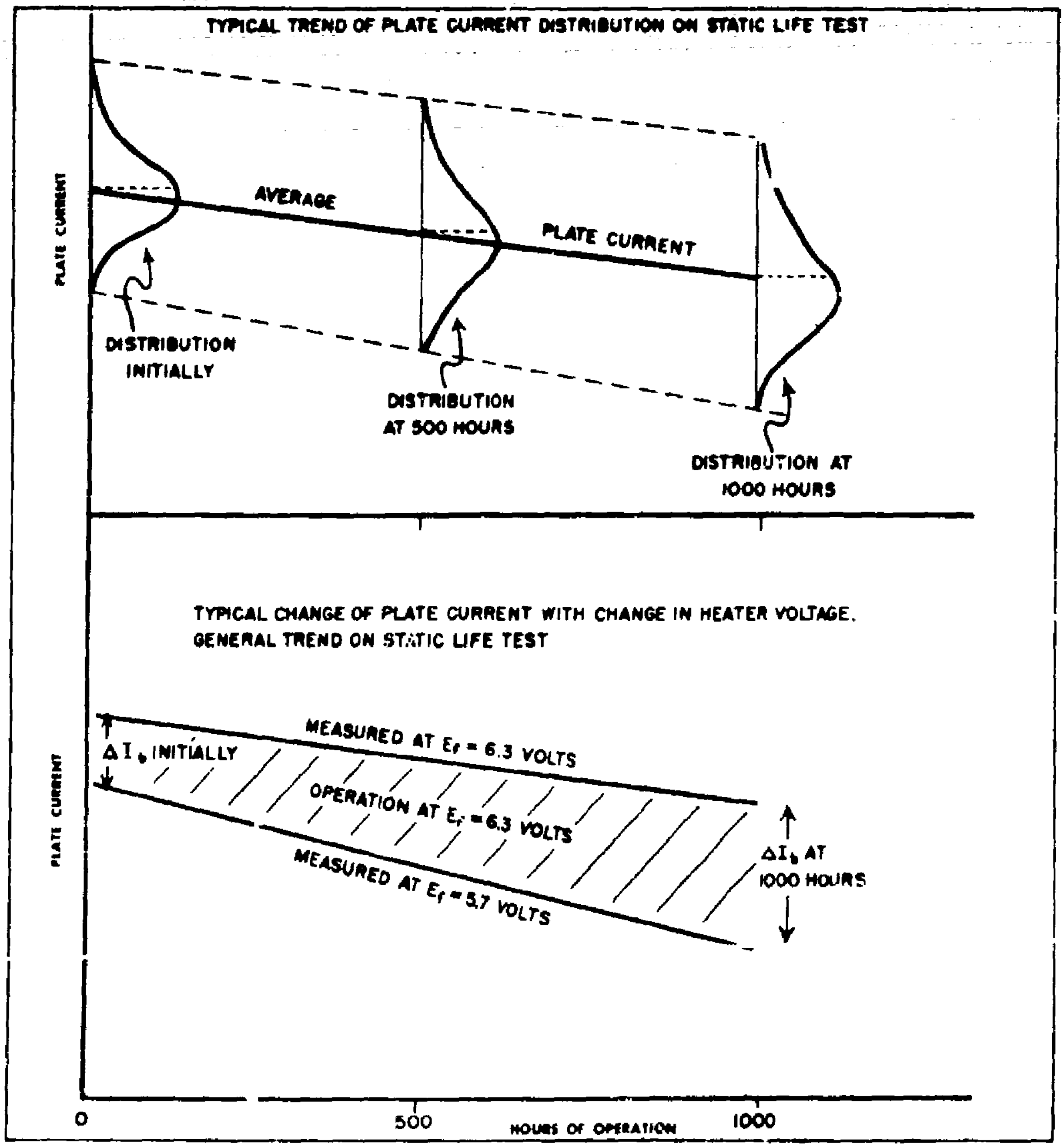


Figure 1-9. Graphs Illustrating Thermionic Instability of a Given Lot of Tubes

1.3.40 The operating value of heater voltage is important to the thermionic stability of the tube throughout its functional life. It has been explained that excessive heater voltage may produce detrimental effects such as interelectrode leakage or spurious emission currents. Operating values of heater voltage less than the rated minimum may produce equally detrimental effects at the cathode itself. It has been observed that in many instances operation at low heater voltage greatly accelerates the decline

of characteristics with life. In addition, low heater voltage accentuates the initial differences in characteristics from tube to tube. Maintenance of operational heater voltage close to the design center value and the minimization of heater voltage changes during operation will be found to increase both the stability and uniformity of electron tube characteristics.

1.3.41 Both the short-term and long-term variations occur in such electrical characteristics as plate current, screen current, transconductance and power output. In most instances, excellent correlation exists between changes in these characteristics. For example, if over a period of time the static plate current of a tube changes by a given percentage, the same percent change is likely to be found in transconductance or power output. In attempting to reduce the effects of thermionic instability through circuit design, this relationship becomes a useful concept in that stabilization of plate current, in most instances, is accompanied by stabilization of transconductance and power output.

1.3.42 The use of cathode bias is a familiar method of stabilizing plate current. In addition, the stabilization of screen current in pentodes is useful in achieving characteristic stability. The effects of cathode bias are outlined in the portion of this handbook covering design calculations. Figure 2-3 shows the effects of limiting cathode current with cathode bias resistance.

1.3.43 The stabilization of tube characteristics may not always be possible by circuit design alone, but the design engineer can ease his problem by utilizing tube types having specifications governing the change of characteristics on life test.

1.3.44 ELECTRON COUPLING EFFECTS.

1.3.45 Consider an electrode in a tube so arranged in position and potential that it intercepts electrons from the electron stream. If the electron stream is modulated, a voltage may be produced at the electrode which will be in phase with the modulation, provided the electrode load is resistive. If the electrode is so arranged by either position or potential that it does not actually intercept electrons from the electron stream, a voltage may nevertheless result from capacitive coupling between the electrode and the modulated electron stream. The voltage will in this case not be in phase with the modulation when the electrode load is resistive. Such an out-of-phase voltage may give rise to undesired effects, particularly if the electrode is a control or signal grid.

1.3.46 In the case of pentagrid converters, some observations indicate a variation in conversion gain from the signal grid which is believed to result from capacitive coupling to a space charge in the region between the second and third grids. The density of such a space charge and hence its charge with respect to the signal grid, varies at the oscillator frequency. This introduces an oscillator frequency current component on the signal grid circuit approximately in quadrature with the voltage of the oscillator grid. Since the signal grid load usually appears capacitive at the oscillator frequency, the resulting voltage component at the signal grid may be out of phase with the oscillator and tend to degenerate the effect of the oscillator in the signal grid region, thereby reducing the conversion gain. This effect, like

amplifier input loading, becomes more pronounced as the frequency of operation is increased; however, unlike amplifier input loading, it may occur at frequencies relatively low with respect to the electron transit time.

1.3.47 The effect of electrode coupling to a space charge is largely dependent upon the external circuitry. Extreme variations may be expected within the confines of the tube specification. Consequently, caution should be exercised in the use of capacity neutralization between the oscillator and signal grids. Some tubes will require no neutralization, but others may require appreciable neutralizing capacity to encompass all the variables which must be compensated for or neutralized at one operating point. Also the circuit must be such as to maintain neutralization over the range of operating points encountered in functional use.

1.3.48 In the case of high-frequency amplifiers and mixers, this coupling effect combines with phase shifts in the electron stream itself due to transit time and with tube reactances to produce an effective change in the input impedance of the tube as either the bias or the input frequency is changed. This relationship is such that usually the resistive component decreases and the capacitive component increases as frequency or cathode current is increased below the point of tube resonances. This effect is illustrated in Figures 1-10 and 1-11. Input-conductance data can be used only to indicate the nature of one tube type relative to another rather than the actual magnitude in any one type.

1.3.49 The magnitude of this impedance and its change with frequency are largely a function of tube geometry and lead configuration and, therefore, may vary widely

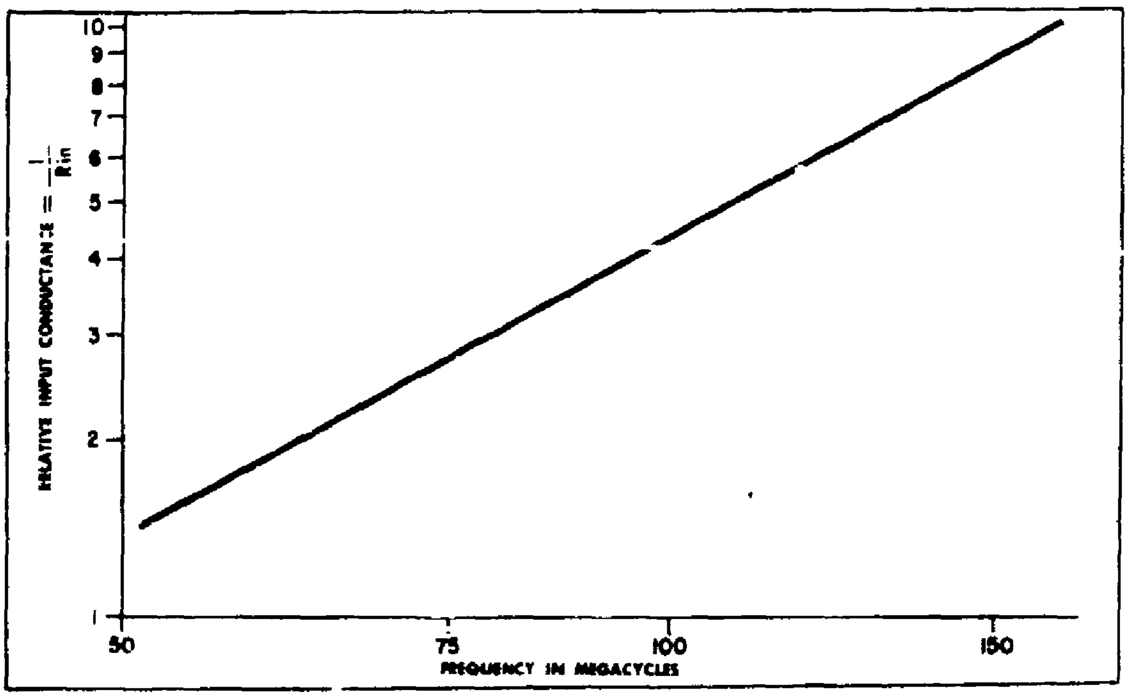


Figure 1-10. Typical Change of Input Conductance with Frequency
(Output Short-Circuited)

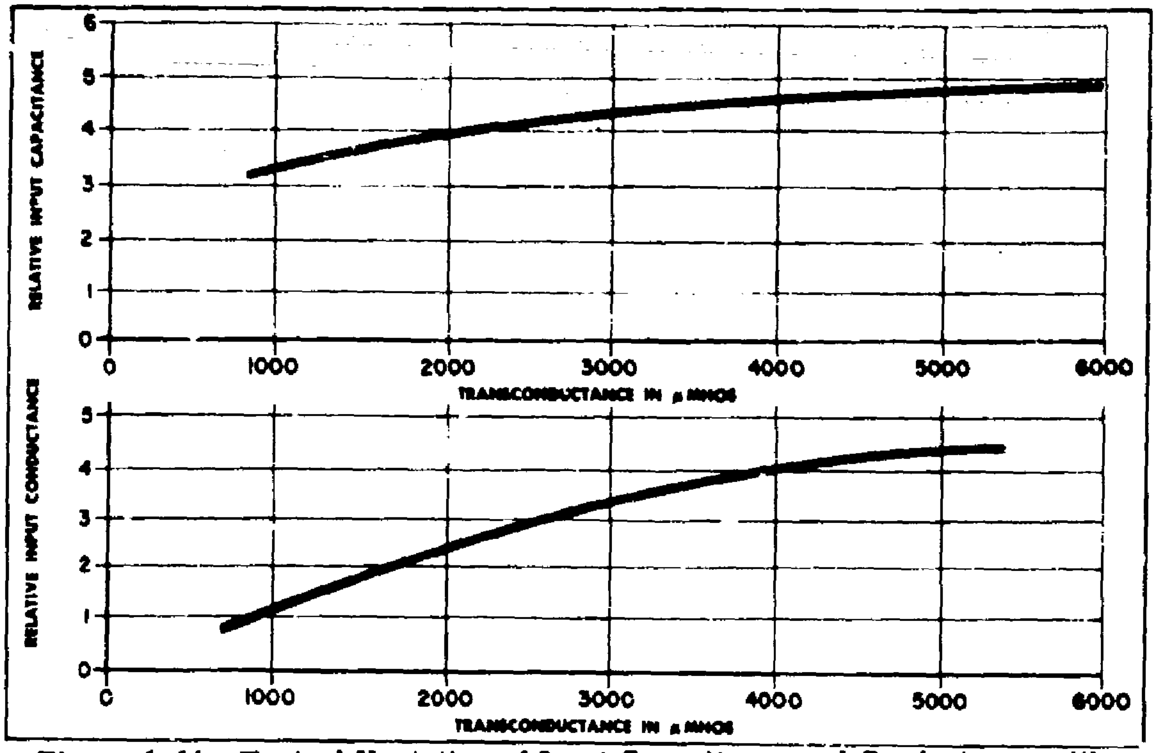


Figure 1-11. Typical Variation of Input Capacitance and Conductance with Transconductance at 100 Megacycles (Output Short-Circuited)

within the confines of the tube specification. Further, the effects of the impedance upon operation is definitely affected by small changes in the circuit constants. Consequently, extreme caution must be exercised in the use of any means to compensate or neutralize this effect (such as plate inductance neutralization). Not only must adequate range be provided to encompass all the variables which must be compensated or neutralized at one operating point, but also the circuit must be such as to maintain neutralization over the range of operating points encountered in functional use.

1.3.50 CATHODE INTERFACE RESISTANCE.

1.3.51 "Interface Resistance" is a name that has been given to a condition that can develop at the cathode of an electron tube. This condition is effectively a parallel resistance and capacitance in series with the cathode. For circuit design purposes, the result is analogous to that of a partially bypassed cathode resistor external to the tube. Normally the formation of this Resistance requires a considerable amount of operating time. However, the development is often hastened by operation of the tube under conditions of little or no cathode current. Operation of the tube at high heater voltage appears to further accelerate the process, as illustrated in Figure 1-12.

1.3.52 Although Interface Resistance is often associated with operation under conditions of no plate current, greatly accelerated formation of the Resistance has also

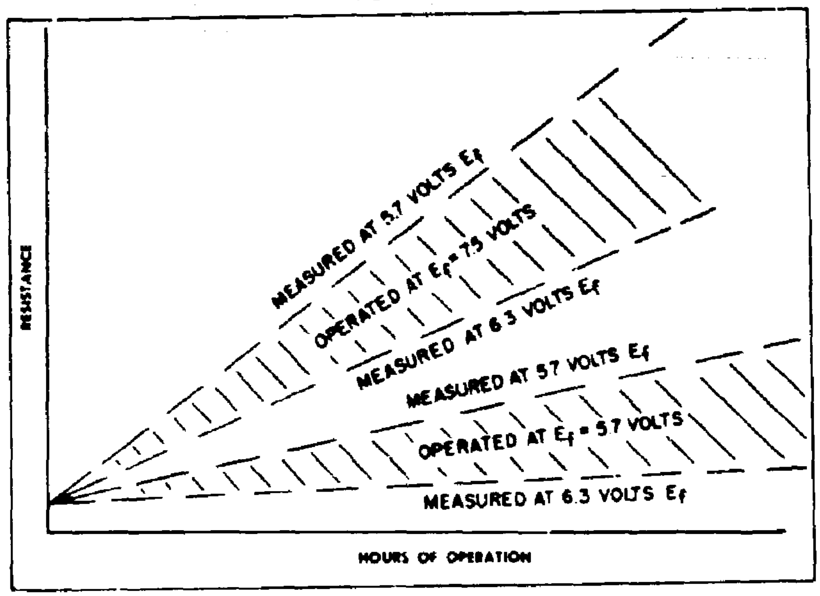


Figure 1-12. Typical Formation of "Interface Resistance" Condition Under Cutoff Condition of Cathode Current

. ᷊ noted in high-peak current, low duty-cycle applications where the average cu ᷊nt is quite low.

1.3.53 The effective value of the Interface Resistance is very much a function of cathode temperature and consequently applied heater voltage, greatly increasing as heater voltage is reduced. Values greater than 300 ohms are not uncommon at rated heater voltage, and resistance values several times this may be experienced at reduced heater voltage. This effect is shown in Figure 1-12. The equivalent value of the shunting capacity is usually in the range of .001 to .01 microfarad.

1.3.54 The effect of Interface Resistance upon an operating circuit is best determined in each individual case by consideration of the Interface Resistance and its shunting capacity as a partially bypassed cathode resistor. The limiting of low-frequency peak currents and distortion of pulse inputs is evident.

1.3.55 The design engineer should attempt to avoid the condition of high heater voltage which may hasten the development of this condition, or low heater voltage which accentuates the effect. Caution must be exercised in the choice of tube type. Unless the tube specification adequately governs this phenomenon, trouble may develop in the equipment after a period of tube operation. Cathode Interface Resistance is seldom controlled directly in specifications. Reliance is placed on life-test controls of transconductance change in the individual tube either with time or with heater voltage to indicate the presence of this effect.

1.3.56 MICROPHONIC OUTPUT.

1.3.57 In general, the cause of microphonic tendency in tubes lies in looseness of tube elements in their spacers and inadequate methods of anchoring tube parts. This condition gives rise to considerable variation both in the frequency and amplitude of output from one tube to another.

1.3.58 Checking a circuit design for microphonics with a few randomly selected tubes usually yields an optimistic result. Consideration should be given to the limiting value of the tube specification rather than the average output of a small group of tubes when checking operation.

1.3.59 The mechanical stimulus imparted to the tube elements may be reduced by acoustical or mechanical isolation and particularly by damping of chassis resonances.

1.3.60 The assurance of satisfactory control of microphonic tendencies in the tube itself can be afforded only by the applicable specification for the tube type.

PART II

TUBE PROPERTIES IN CIRCUIT DESIGN

2. GENERAL.

2.01 The manner in which the various electron-tube properties must be treated in circuit design calculations differs widely depending upon the nature of the property. The electronic equipment designer may visualize the nature of a specific tube type for circuit-design purposes by considering the three categories of tube properties subject to specification control:

2.02 RATINGS. (e.g., maximum dissipations, maximum bulb temperature). The set of limiting values defining each individual operating condition within which the tube can be expected to yield a nominal period of satisfactory service.

2.03 CONTROLLED CHARACTERISTICS. (e.g., transconductance, plate current, capacitance). Properties of the tube essential to the operation of the circuit. They exist within a distinct range of values, defined by specification for each individual type number.

2.04 CONTROLLED DETRIMENTS. (e.g., heater-cathode leakage, electrode insulation). Inherent tube properties which must be considered in circuit design on the basis of their detrimental effects upon circuit operation. They have no defined distribution of values, but instead are restricted by a single limit upon the magnitude or the frequency of occurrence of the property.

2.05 Each of these categories differs from the others in the method of treatment in design calculations.

SECTION 1

RATINGS

2.1 RATING PROBLEMS.

2.1.1 Since ratings are in effect boundaries limiting the operating conditions of the tube, they can often be represented by graphical plots as in Figure 2-1. Two questions are posed by each rating:

a. What mode of operation imposes the most severe condition upon the tube?

b. Under the most severe condition is the tube operated beyond the rating?

2.1.2 As an example, consider a Class A power amplifier. The maximum plate dissipation occurs with no applied input signal, whereas the largest screen dissipation occurs at maximum input-signal conditions. Each rating must be treated

separately under its most severe individual condition, which must be determined by the judgment of the circuit design engineer.

2.1.3 Typical graphical solutions of rating problems in electrode dissipation and cathode current are shown in Figures 2-2 and 2-3.

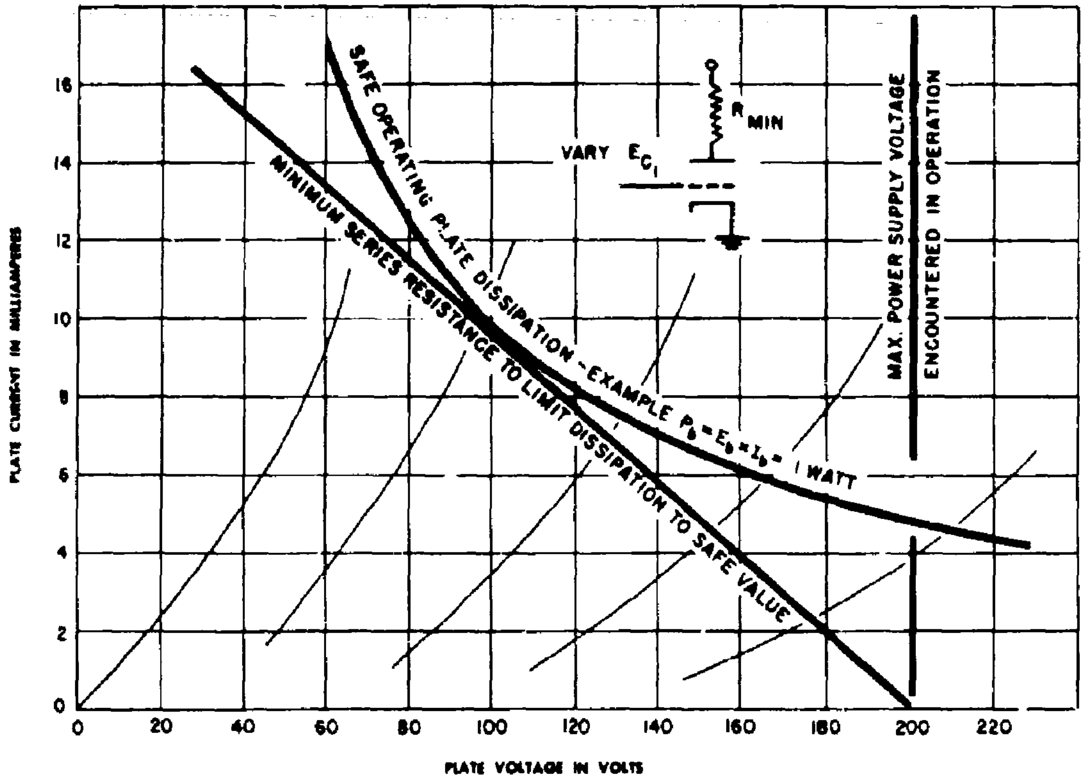


Plate dissipation may be restricted to values less than the safe operating maximum by the use of series resistance between plate and power supply. The minimum value of resistance can be determined by plotting a load line tangential to the curve $E_b \times I_b$ = safe dissipation. If the load line is started at the maximum operating value of supply voltage, its equivalent resistance will limit plate dissipation to a safe value despite variation in tube characteristics, bias and supply voltage. The minimum value of resistance may also be found from the relationship:

$$R_{min} = \frac{(E_{bb})^2}{4P_b}$$

E_{bb} = maximum supply voltage

P_b = safe dissipation in watts

Figure 2-1. Limiting Electrode Dissipation with Series Resistance

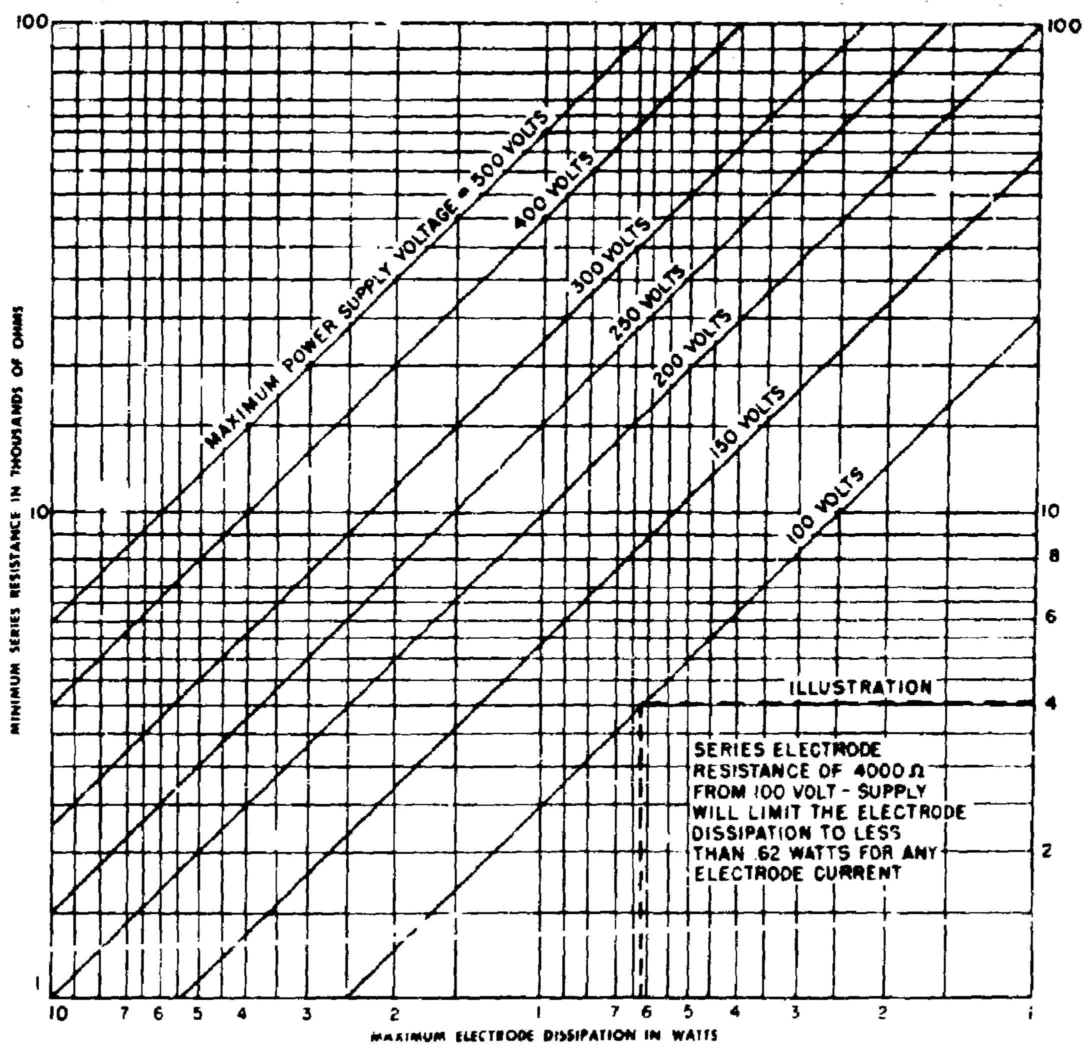
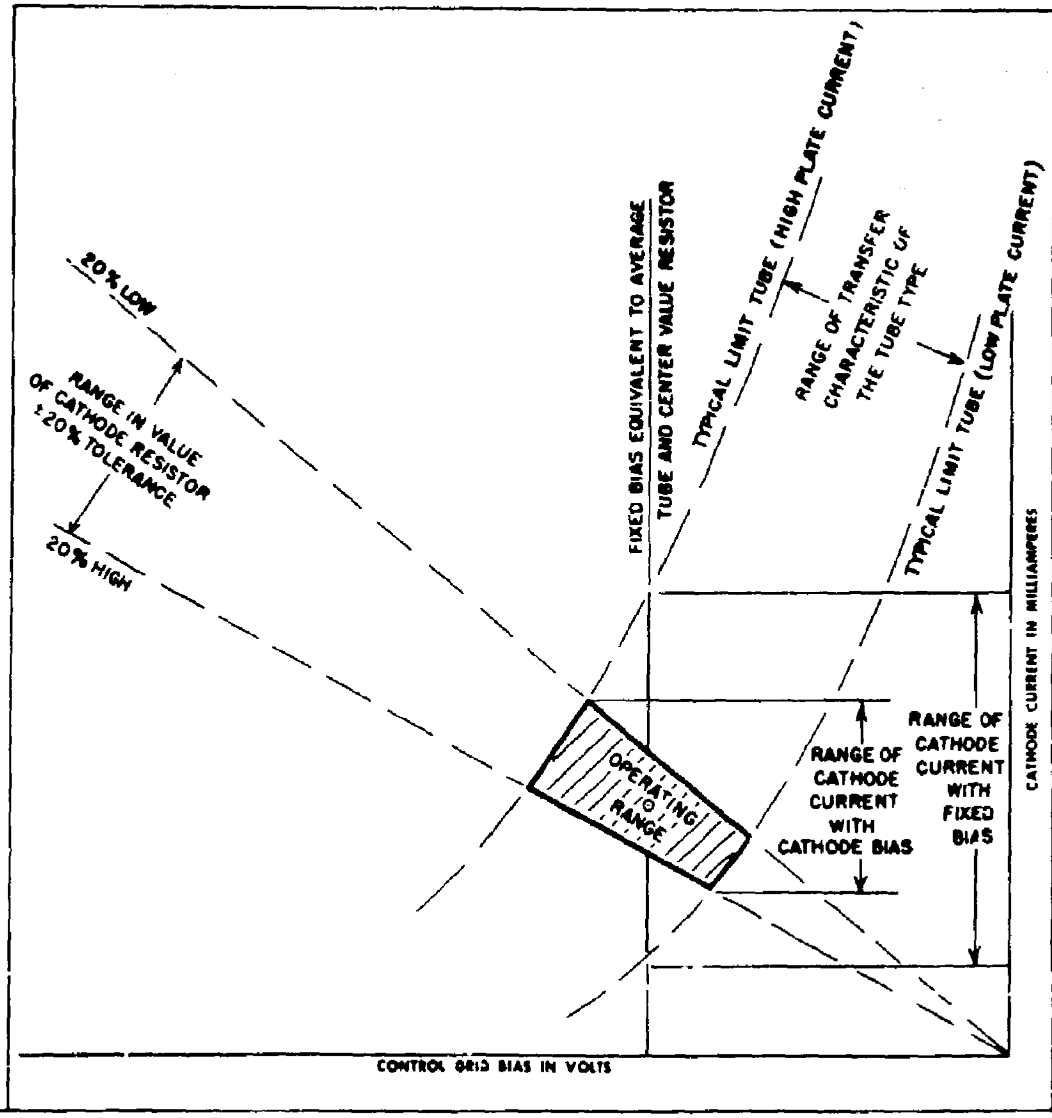


Figure 2-2. Graph for Determining Series Electrode Resistance to Limit Electrode Dissipation to a Given Value when a Specific Power Supply Voltage is Used



The operating range of quiescent plate current in circuits utilizing cathode bias will depend upon cathode resistance and cathode current as illustrated above. It should be noted that the operating range of cathode current is materially reduced by the use of cathode bias as opposed to fixed bias. Reference to the tube of maximum cathode current will determine if any portion of the operating range lies at or near the rating.

Figure 2-3. Limiting Cathode Current with Cathode Bias Resistance

2.2 GENERAL.

2.2.1 Characteristics are defined as properties of a tube essential to the operation of the circuit. Three questions arise concerning tube characteristics in circuit-design calculations:

a. What tube characteristics are required for the intended circuit function?

b. Does the applicable MIL-E-1 Specification control these characteristics?

c. Will the circuit operate satisfactorily with tubes having the range of characteristics allowable in the specification?

2.2.2 The method recommended for determining whether a circuit will give satisfactory performance for the entire specified range of the required characteristic is to compute performance, using both the upper and lower specified values. If the design criteria are not adequately treated in the available literature, or the circuit is too complicated to permit direct calculation of performance, the circuit designer may still determine the relation between tube characteristics and circuit operation by the method outlined below.

2.2.3 CHARACTERISTIC TOLERANCES.

2.2.4 The effect of tube-characteristic tolerances cannot be adequately determined by checking performance with tubes of only one lot. Tubes must be obtained approximating the total range allowed by the specification. Reference must also be made to the life-test end points of the specification to determine the permitted condition of the tube after a prolonged period of operation.

2.2.5 DETERMINING COMPATIBILITY OF LIMIT TUBES.

2.2.6 Although it is desirable that tubes representing the entire range allowed by the tube specification be used to determine the performance limits of the circuit, it is quite difficult to obtain tubes which are exactly on the tube limits for even one characteristic. Nevertheless, the important matter of operation with limit tubes is not to be treated lightly. To predict a circuit's acceptance of limit tubes even though limit tubes are not available, the following procedure is recommended:

a. Obtain a suitable sample group of tubes representing as wide a range of characteristic values as possible. (Size of sample depends upon individual cases; the larger the sample, however, the better the chance of obtaining significant results. Fifty to 100 tubes should be adequate in most instances.)

b. Obtain readings on the tubes for all characteristics considered important to the operation of the circuit.

c. Determine the correlation between circuit performance and tube characteristics, taking into consideration the tolerances of other circuit components.

d. If the correlation proves to be significant, the estimating equation and the confidence limits are used to determine the circuit performance limits required to assure operation when limit tubes are used.

2.2.7 DETERMINATION OF CORRELATION.

2.2.8 The coefficient of correlation must be thought of, not as something that indicates a particular cause and effect relationship, but only as something that measures covariation. The validity of the correlation coefficient in expressing the measure of covariation is referred to as the significance of the correlation. Significance is usually expressed as the probability of the correlation occurring by chance alone. It takes into account the degree of correlation as well as the number of observations which comprise the data.

2.2.9 Two methods for determining the coefficient of correlation will be described. One is based on computations using the deviation of individual readings from the mean value of the readings. The other is an approximate method which requires considerably less time and usually yields sufficiently accurate results for most problems encountered in an engineering evaluation of circuit-tube performance. In both instances similar methods are utilized to determine the significance of a particular correlation. Although in use the approximate method saves considerable time, its proper application is most easily understood after the basic principles of the method of deviations are mastered. For this reason the longer method is presented first.

2.2.10 SIMPLE LINEAR CORRELATION. The first step in any correlation problem is to make a scatter plot of the data. Consider the data tabulated in Table 2-1, where the plate current readings of a sample lot of tubes, as read under the conditions specified in the tube specification, are recorded with the corresponding circuit performance readings (output current in this case). A point-by-point scatter plot of these data is shown in Figure 2-4. It appears from Figure 2-4 that a linear relationship exists between test-point plate current and the output current of the circuit. The case of non-linear correlation will be considered later. It will then be demonstrated that the procedures outlined for simple linear correlation can be used after some simple transformations are applied.

2.2.11 CALCULATIONS BASED ON DEVIATIONS. After the scatter diagram has been made, a table is compiled containing the sum of the products of the two variables. Such a table is shown, for our sample problem, as Table 2-2. Using the equations shown in Figure 2-5, the coefficient of correlation, the coefficients of the estimating equation, and the standard error of estimate are calculated, as indicated in Figure 2-6. The coefficient of correlation, (r), takes the same sign as the slope, (a), of the estimating equation. When a minus sign appears in the calculated value of (a) and, consequently, (r), the correlation is said to be negative. This means that as the values for the tube characteristic increase, the values for the circuit performance parameter decrease. When a plus sign appears in the calculated value of (a), the correlation is said to be positive. Consequently as the values for the tube characteristic increase, the values for the circuit performance parameter also increase.

2.2.12 The estimating equation is the equation of that line which most nearly represents the average of the scatter plot. In the case of linear correlation, it is the equation for a straight line expressed in the slope-intercept form, $Y = aX + b$, where (a) is the slope and (b) is the Y intercept.

TABLE 2-1. PLATE CURRENT VS. CIRCUIT CURRENT

Tube No.	Plate Current	Circuit Current	Tube No.	Plate Current	Circuit Current	Tube No.	Plate Current	Circuit Current
1	8.10	4.54	18	8.00	4.50	35	7.80	4.42
2	8.90	4.90	19	8.40	4.61	36	7.20	4.26
3	7.40	4.29	20	7.30	4.30	37	7.50	4.36
4	7.00	4.14	21	8.25	4.57	38	7.40	4.32
5	7.80	4.54	22	7.20	4.24	39	7.00	4.26
6	7.75	4.47	23	7.15	4.34	40	7.15	4.32
7	7.25	4.38	24	7.70	4.38	41	7.40	4.38
8	7.80	4.44	25	7.70	4.53	42	6.80	4.17
9	7.40	4.40	26	7.55	4.40	43	8.00	4.50
10	8.90	4.78	27	7.70	4.46	44	7.10	4.26
11	7.55	4.49	28	8.65	4.80	45	7.15	4.21
12	8.00	4.56	29	6.75	4.10	46	7.75	4.46
13	7.75	4.44	30	7.45	4.34	47	7.00	4.20
14	8.10	4.64	31	7.80	4.52	48	7.40	4.36
15	8.40	4.69	32	7.15	4.28	49	7.45	4.44
16	7.10	4.30	33	7.20	4.30	50	7.60	4.44
17	8.15	4.68	34	7.10	4.22			

TABLE 2-2. TABULATIONS OF SQUARES AND CROSS PRODUCTS

Tube No.	X	X^2	Y	Y^2	XY
1	8.10	65.610	4.54	20.612	36.774
2	8.90	79.210	4.90	24.010	43.610
3	7.40	54.760	4.29	18.041	31.746
4	7.00	49.000	4.14	17.140	28.980
5	7.80	60.840	4.54	20.612	35.412
6	7.75	60.063	4.47	19.981	34.625
7	7.25	52.563	4.38	19.184	31.755
8	7.80	60.840	4.44	19.714	34.632
9	7.40	54.760	4.40	19.360	32.560
10	8.90	79.210	4.78	22.848	43.542
11	7.55	57.003	4.49	20.160	33.899
12	8.00	64.000	4.56	20.794	36.480
13	7.75	60.063	4.44	19.714	34.410
14	8.10	65.610	4.64	21.530	37.584
15	8.40	70.560	4.69	21.996	39.396
16	7.10	50.410	4.30	18.490	30.530
17	8.15	66.423	4.68	21.902	38.142
18	8.00	64.000	4.50	20.250	36.000
19	8.40	70.560	4.61	21.252	38.724
20	7.30	53.290	4.30	18.490	31.390

Continued

TABLE 2-2. TABULATIONS OF SQUARES AND CROSS PRODUCTS (Cont.)

Tube No.	X	X^2	Y	Y^2	XY
21	8.25	68.063	4.57	20.885	37.703
22	7.20	51.840	4.24	17.978	30.528
23	7.15	51.123	4.34	18.335	31.031
24	7.70	59.290	4.38	19.184	33.726
25	7.70	59.290	4.53	20.521	34.881
26	7.55	57.003	4.40	19.360	33.220
27	7.70	59.290	4.46	19.892	34.342
28	8.65	74.823	4.80	23.040	41.520
29	6.75	45.563	4.10	16.810	27.675
30	7.45	55.503	4.34	18.836	32.333
31	7.80	60.840	4.52	20.430	35.256
32	7.15	51.123	4.28	18.318	30.602
33	7.20	51.840	4.30	18.490	30.960
34	7.10	50.410	4.22	17.893	29.962
35	7.80	60.840	4.42	19.536	34.476
36	7.20	51.840	4.26	18.148	30.672
37	7.50	56.250	4.36	19.010	32.700
38	7.40	54.760	4.[illegible]	18.662	31.968
39	7.00	49.000	4.26	18.148	29.820
40	7.15	51.123	4.32	18.662	30.888
41	7.40	54.760	4.38	19.184	32.412
42	6.80	46.240	4.17	17.389	28.356
43	8.00	64.000	4.50	20.250	36.000
44	7.10	50.410	4.26	18.148	30.246
45	7.15	51.123	4.21	17.724	30.111
46	7.75	60.063	4.46	19.892	34.565
47	7.00	49.000	4.20	17.640	29.400
48	7.40	54.760	4.36	19.010	32.264
49	7.45	55.503	4.44	19.714	33.078
50	7.60	57.760	4.44	19.714	33.744
TOTAL	380.10	2899.464	220.93	977.659	1683.046
MEAN	7.602		4.4186		

X = Test-point plate current in milliamperes
Y = Circuit output current in milliamperes

2.2.13 S_y, the standard error of estimate, defines the range above and below the line of estimation within which 68.27 percent of the items in the scatter plot will fall if the scatter follows a normal distribution about the line of estimation. In practice, this is frequently thought of as the range within which 2/3 of the items are found. To determine the extent of the variation that can be expected for a large sample of items, a range $\pm 2S_y$, centered on the line of estimation, should be marked off as shown in Figure 2-7. Approximately 95 percent of the lot represented by the sample will fall between lines marked "confidence limits".

2.2.14 Once the degree of correlation has been determined and the line of estimation and confidence limits have been established, the engineer is in a position to

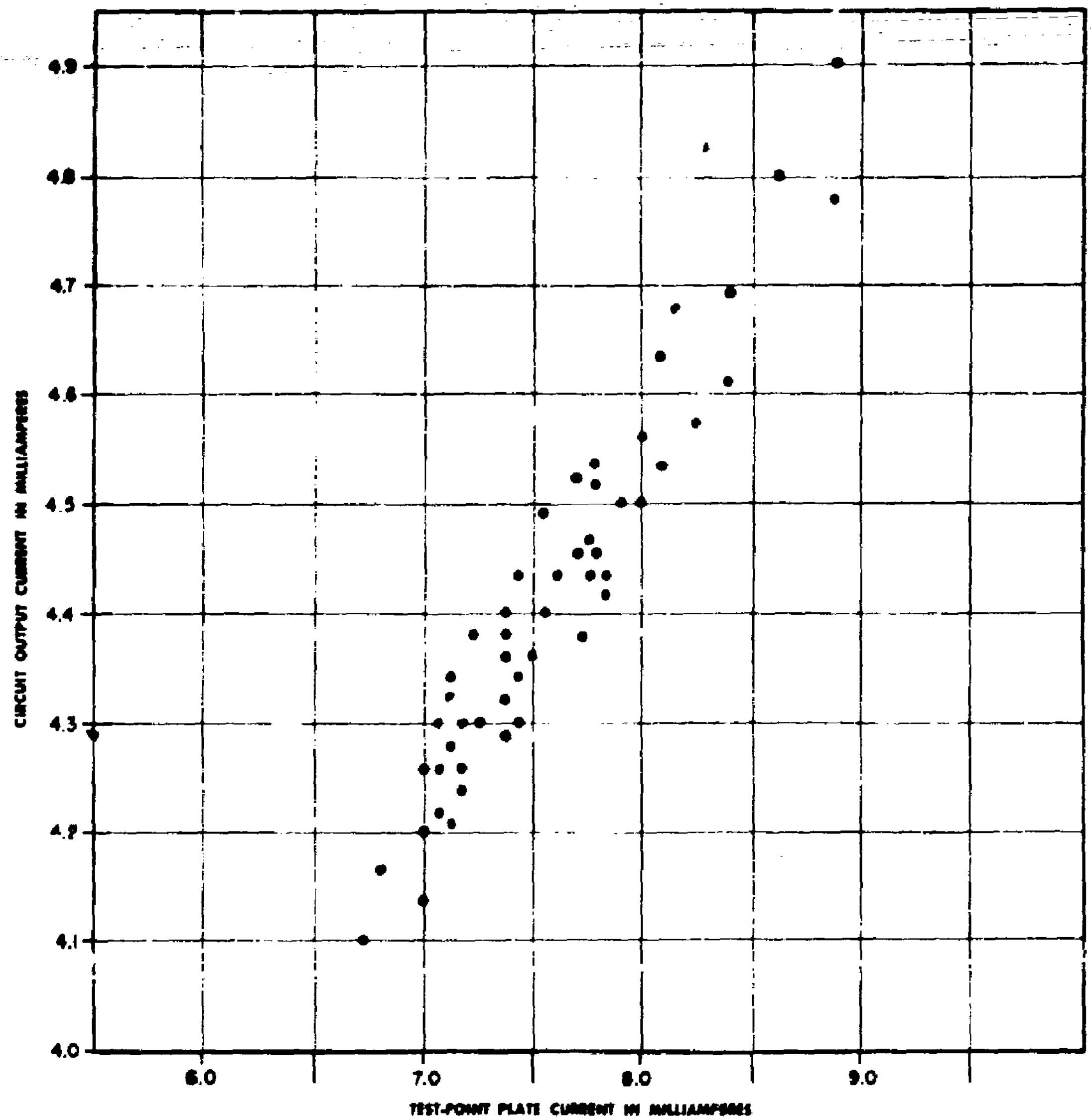


Figure 2-4. Scatter Plot of Data in Table 2-1 Showing a Linear Relationship Between Test-Point Plate Current and Circuit Output Current

predict the limits of circuit performance assured by the limits provided in the tube specification, without actually testing limit tubes in the circuit.

2.2.15 TEST OF SIGNIFICANCE OF CORRELATION COEFFICIENT. Significance, as applied to the coefficient of correlation, refers to the probability that the observed c rrelation is not the result of chance. As the probability of chance occur-

rence decreases, the significance of the coefficient of correlation increases. The significance of the correlation coefficient is determined by comparing the value of F calculated from the coefficient of correlation (r), using the equation shown in Figure 2-5, with the value of F corresponding to (N-2) in Table 2-3, where N is the number of items in the sample. Table 2-3 has three columns of numbers corresponding to the probability of a particular F value's occurrence due to chance alone.

2.2.16 In the example, F is calculated to be 304 as is illustrated in Figure 2-6. The "F" table is entered at $N-2 = 48$. Since F as calculated is greater than 12.61, the probability of this degree of correlation existing as a result of chance alone is less than one in a thousand. The correlation is, therefore, highly significant. When the probability of an F value's occurrence due to chance is less than .01, the coefficient of correlation can be considered quite significant since only one time in one hundred can it be expected to occur as the result of chance alone.

2.2.17 Significant correlation and useful correlation must not be confused. The significance of the correlation when determined as outlined indicates the validity of the assumption that the observed correlation is not the result of a chance occurrence. It implies nothing directly as to either the degree or the practical usefulness of the correlation. It is impossible generally, to assign a criterion of "acceptable or useful" correlation. The usefulness of an observed correlation depends upon other factors and must be judged in each individual case. If the dispersion of the points about the line of estimation is too great, the correlation, even though highly significant, may be useless for evaluating a practical circuit problem. If the degree of correlation is poor but its significance is high, it is suggested that other tube characteristics be examined as possibly better indicators of circuit performance. In the event that a high degree of correlation appears to exist, but the significance is poor, it is suggested that a larger sample be taken to better determine the significance.

2.2.18 DETERMINATION OF PERFORMANCE LIMITS. Using the equations for the two confidence limits, it is possible to determine the limits of circuit performance, from the viewpoint of the criterion used to gage operation. For negative correlation, proceed as follows:

a. Substitute the lower end of life tube specification limit into the equation for the upper confidence limit and solve for the upper circuit limit.

b. Substitute the upper tube specification limit into the equation for the lower confidence limit and solve for the lower circuit limit.

For positive correlation, do the following:

a. Substitute the lower end of life tube specification limit into the equation for the lower confidence limit and solve for the lower circuit limit.

b. Substitute the upper tube specification limit into the equation for the upper confidence limit and solve for the upper circuit limit.

2.2.19 This procedure is demonstrated graphically in Figure 2-8. In the illustrative problem, the correlation was found to be positive; substituting 5.9, the lower tube limit on plate current, into the equation for the lower confidence limit, $Y = .356 X + 1.586$, it is determined that Y, the lower circuit limit required to permit the use of a low limit tube, is 3.686. Substituting 10.5, the upper tube limit on

EXACT METHOD

$$y = Y - \bar{Y} \qquad x = X - \bar{X}$$

$$\Sigma y^2 = \Sigma Y^2 - \bar{Y}\Sigma Y \qquad \Sigma x^2 = \Sigma X^2 - \bar{X}\Sigma X$$

$$\Sigma xy = \Sigma XY - \bar{Y}\Sigma X \qquad \Sigma xy = \Sigma XY - \bar{X}\Sigma Y$$

$$\bar{X} = \frac{\Sigma X}{N} \qquad \bar{Y} = \frac{\Sigma Y}{N}$$

ESTIMATING EQUATION

$$Y = aX + b$$

a = SLOPE
b = Y INTERCEPT

$$a = \frac{\Sigma xy}{\Sigma x^2} \qquad b = \bar{Y} - a\bar{X}$$

COEFFICIENT OF CORRELATION

$$r = \sqrt{\frac{(\Sigma xy)^2}{\Sigma y^2 \Sigma x^2}}$$

STANDARD ERROR OF ESTIMATE

$$S_y = \sqrt{\frac{\Sigma y^2 - \frac{(\Sigma xy)^2}{\Sigma x^2}}{N-2}}$$

WHEN LARGE SAMPLES (AS RECOMMENDED) ARE USED, $N \gg 2$, THE FORMULA MAY BE SIMPLIFIED SLIGHTLY BY USING N IN PLACE OF N-2 AND THE APPROXIMATION WILL BE SUFFICIENT.

$$S_y = \sqrt{\frac{\Sigma y^2 - \frac{(\Sigma xy)^2}{\Sigma x^2}}{N}}$$

95% CONFIDENCE LIMITS

$$Y = aX + b \pm 2S_y$$

TEST OF SIGNIFICANCE

$$F = \frac{(N-2)r^2}{1-r^2}$$

APPROXIMATE METHOD

COEFFICIENT OF CORRELATION

$$r = \sqrt{1 - \frac{S_y}{\sigma y}}$$

ESTIMATING EQUATION

$$Y - Y_1 = \frac{Y_1 - Y_2}{X_1 - X_2}(X - X_1)$$

Figure 2-5. Formulae for Determining Correlation

$$\Sigma X = 380.10 \qquad \Sigma Y = 220.93 \qquad \Sigma X^2 = 2899.464 \qquad \Sigma Y^2 = 977.659$$

$$\bar{X} = \frac{\Sigma X}{N} = 7.602 \qquad \bar{Y} = \frac{\Sigma Y}{N} = 4.4186 \qquad \Sigma XY = 1683.046$$

$$\Sigma x^2 = \Sigma X^2 - \bar{X}\Sigma X = 2899.464 - 2889.52 = 9.944$$

$$\Sigma y^2 = \Sigma Y^2 - \bar{Y}\Sigma Y = 977.659 - 976.201 = 1.458$$

$$\Sigma xy = \Sigma XY - \bar{Y}\Sigma X = 1683.046 - 1679.510 = 3.536$$

COEFFICIENT OF CORRELATION

$$r^2 = \frac{(\Sigma xy)^2}{\Sigma x^2 \, \Sigma y^2}$$

$$r^2 = \frac{12.5033}{14.498} = .8624 \qquad r = \sqrt{.8624} = \underline{.93}$$

ESTIMATING EQUATION

$$Y = aX + b \qquad a = \frac{\Sigma xy}{\Sigma x^2} \qquad b = \bar{Y} - a\bar{X}$$

$$a = \frac{3.536}{9.944} = .356 \qquad \underline{Y = .356X + 1.712} \qquad b = 4.419 - .356 \times 7.6 = 1.712$$

STANDARD ERROR OF ESTIMATE

$$S_y = \sqrt{\frac{\Sigma y^2 - \frac{(\Sigma xy)^2}{\Sigma x^2}}{N}} = \sqrt{\frac{1.458 - \frac{(3.536)^2}{9.944}}{50}}$$

$$S_y = \pm \underline{.063}$$

95% CONFIDENCE LIMITS

$$Y = aX + b \pm 2S_y$$

UPPER LIMIT $\underline{Y = .356X + 1.838}$

LOWER LIMIT $\underline{Y = .356X + 1.586}$

TEST OF SIGNIFICANCE

$$F = \frac{(N-2)\, r^2}{1 - r^2}$$

$$F = \frac{48 \times .8624}{.1376} = \underline{304}$$

Figure 2-6. Calculation of Simple Correlation Using Deviations

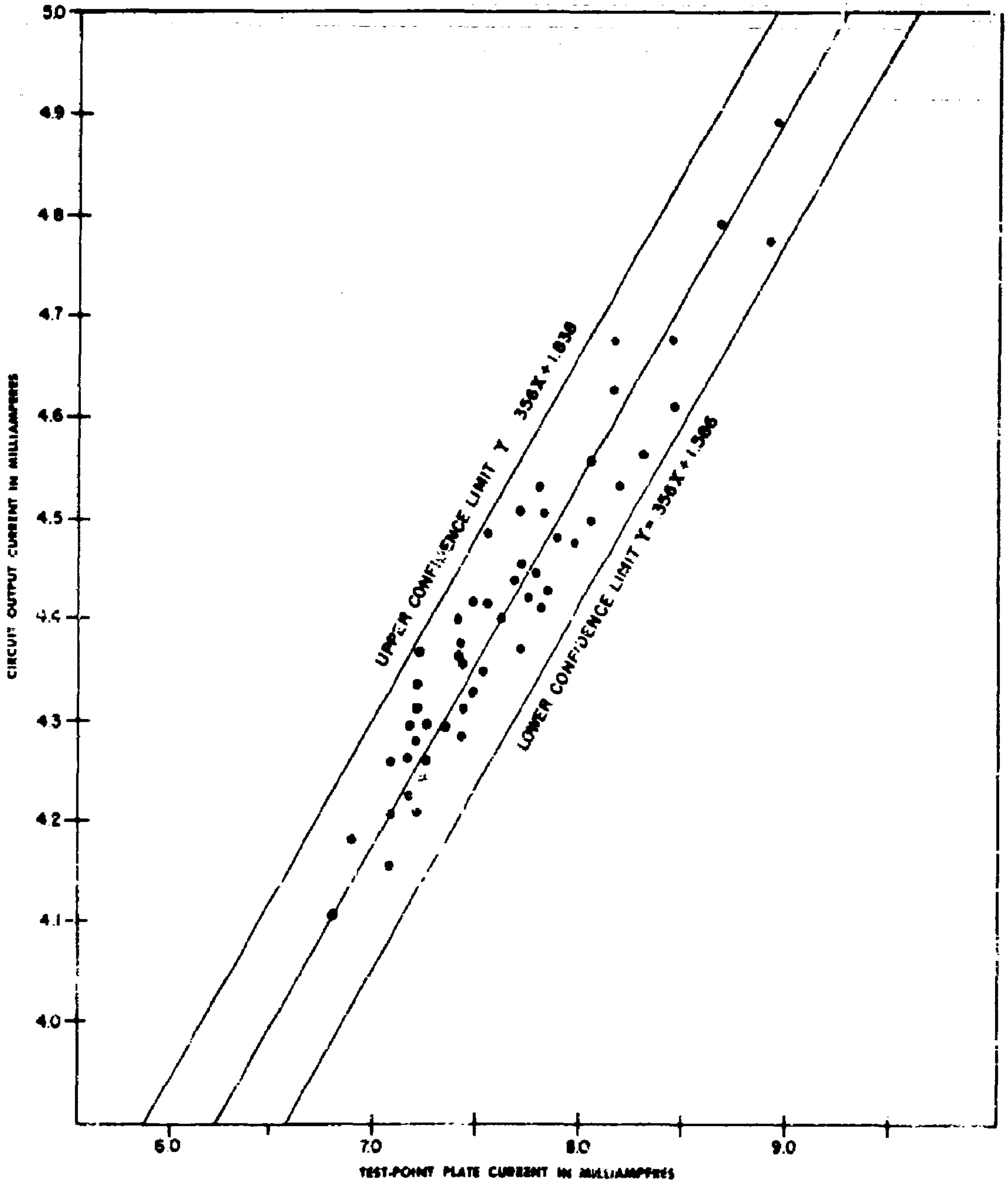


Figure 2-7. Plot of Test-Point Current Against Circuit Output Current with Line of Estimation and Confidence Limits as Calculated from Deviations from Mean

TABLE 2-3

VALUES OF THE FACTOR "F" AND SELECTED LEVELS OF PROBABILITY FOR 1 TO 120 DEGREES OF FREEDOM

VALUES OF F AT SELECTED PROBABILITY							
(N-2)	PROBABILITY OF CHANCE OCCURRENCE			(N-2)	PROBABILITY OF CHANCE OCCURRENCE		
	.05	.01	.001		.05	.01	.001
	F RATIO				F RATIO		
1	161.45	4052.2	405284.0	18	4.414	8.285	15.38
2	18.513	98.503	998.5	19	4.381	8.185	15.08
3	10.128	34.116	167.5	20	4.351	8.096	14.82
4	7.709	21.198	74.14	21	4.325	8.017	14.59
5	6.608	16.258	47.04	22	4.301	7.945	14.38
6	5.987	13.745	35.51	23	4.279	7.881	14.19
7	5.591	12.246	29.22	24	4.260	7.823	14.03
8	5.318	11.259	25.42	25	4.242	7.770	13.88
9	5.117	10.561	22.86	26	4.225	7.721	13.74
10	4.965	10.044	21.04	27	4.210	7.677	13.61
11	4.844	9.646	19.69	28	4.196	7.636	13.50
12	4.747	9.330	18.64	29	4.183	7.598	13.39
13	4.667	9.074	17.81	30	4.171	7.563	13.29
14	4.600	8.862	17.14	40	4.085	7.314	12.61
15	4.543	8.683	16.59	60	4.001	7.077	11.97
16	4.494	8.531	16.12	120	3.920	6.851	11.38
17	4.451	8.400	15.72		3.841	6.635	10.83

plate current, into the equation for the upper confidence limit, $Y = .356 X + 1.838$, it is determined that Y, the upper circuit limit required to permit the use of a high limit tube, is 5.588.

2.2.20 Figure 2-8 is an extrapolation of Figure 2-7 which demonstrates the inadvisability of determining the limits to be applied to circuit performance from a disorganized investigation of a single lot of tubes. The cross-hatched area represents the area covered by the single lot of tubes tested, while the area bounded by the heavy lines represents the possible distribution of tubes allowed by the tube specification. Had the circuit performance limits been based on the single lot tested, without regard to the total possible variation allowed by the tube specification, it is quite probable that the circuit would fail to perform satisfactorily if a lot of tubes representing another portion of the total allowable variation were used. It is also recommended that performance of several hookups of the circuit containing different circuit components be measured to allow for tolerance variations of the other circuit components.

2.2.21 APPROXIMATE METHOD. The second method for determining the coefficient of correlation consists of drawing the line of estimation by inspection. With a little practice, this can be done quite accurately. The equation of this estimated

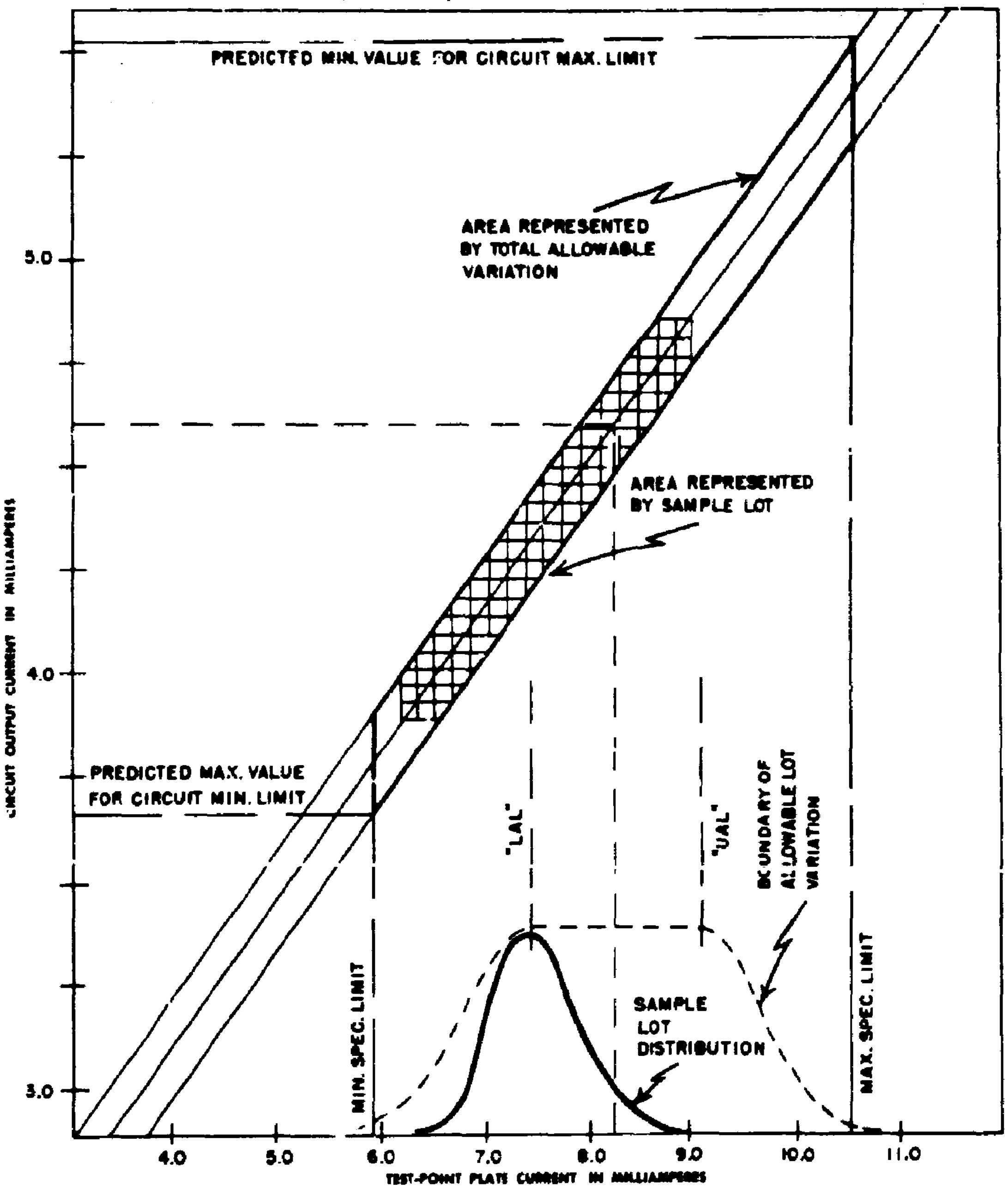


Figure 2-8. Extrapolation of Figure 2-7 Showing Circuit Limits

line can be written from the two-point form of the equation for a straight line. This equation is included in Figure 2-10 for reference.

2.2.22 A line is drawn parallel to the line of estimation in such a manner that 1/6 of the points are above the line, while another line is drawn parallel to the line of estimation in such a manner that 1/6 of the points are below the line. The vertical distance between these lines is approximately $2S_y$. Approximately 2/3 of the items are in the range bounded by these lines. A line parallel to the X axis is drawn so that 1/6 of the points are above the line, and another line parallel to the X axis is drawn so that 1/6 of the points are below the line. The range between these lines represents approximately twice the standard deviation of Y, $2\sigma_y$, or bounds approximately 2/3 of the items. This procedure is shown in Figure 2-9. The coefficient of correlation, (r), is calculated from the equation: $r^2 = 1 - S_y/\sigma_Y$ as indicated in Figure 2-10.

2.2.23 The test of significance is calculated as before, and the confidence limits are drawn parallel to the line of estimation and shifted along the Y axis 2S above and below it, as indicated in Figure 2-9. This system has the obvious advantage of simplicity and yields satisfactory results for most practical problems as indicated from a comparison of the results of the two procedures The accuracy is better as the coefficient of correlation gets larger. The confidence limits are used as before in determining the circuit performance limits.

2.2.24 In the example used to demonstrate the two methods for determining the coefficient of correlation, the plate current as measured under specification conditions was compared with a measurement of circuit performance. For the obvious reason that specification conditions are the only conditions which have accompanying limits, the circuit designer should always attempt to correlate circuit performance with tube characteristics measured under specification conditions. Occasionally it is impossible to correlate circuit performance with a tube characteristic when measured under the conditions referred to in the tube specification. When this happens and good correlation is observed to exist between circuit performance and a tube characteristic measured under other than specification conditions, it is to the advantage of the circuit designer to change his circuit so that correlation can be obtained between circuit performance and specified tube test conditions. When this cannot be done, and a requirement for an additional test condition exists, the circuit designer should take steps necessary to have an addition made to the tube specification through the normal military and industry channels set up for this purpose. This should be done only when correlation does not exist between circuit performance and normally specified test conditions.

2.2.25 NON-LINEAR CORRELATION. Frequently the points on the scatter diagram will cluster more closely about a curved rather than a straight line. To determine the correlation between two variables which bear such a relationship, it is sometimes desirable to plot some function of the variables which will render a linear plot. A number of procedures involving the use of logarithms can be followed with good success. Suppose it is desired to determine the correlation between time delay of a circuit and the static plate current of the tube as measured under standard test conditions. As in all correlation problems, the first step is to

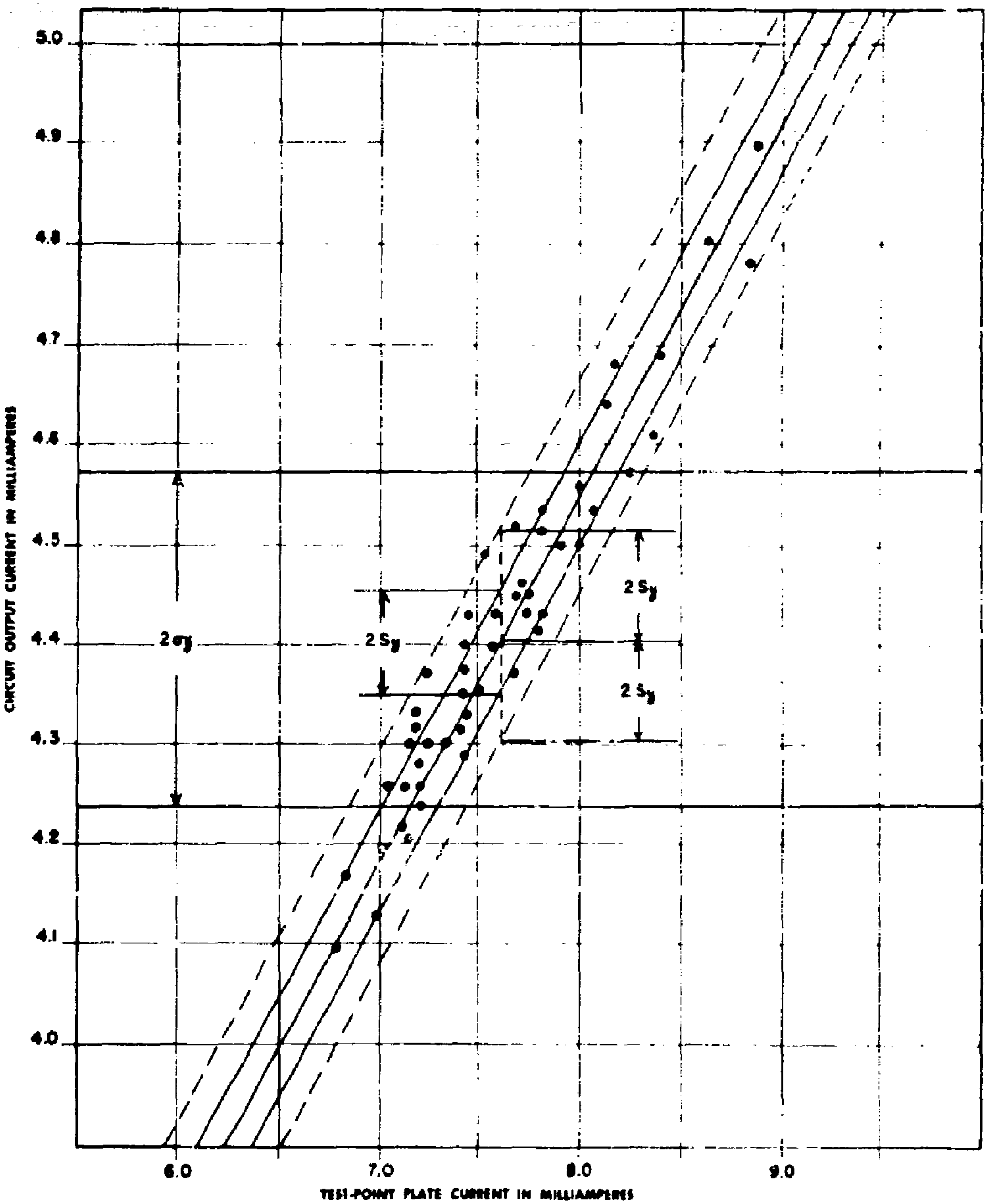


Figure 2-9. Plot of Test-Point Current Against Circuit Output Current to Illustrate Approximate Method of Determining Correlation

COEFFICIENT OF CORRELATION

$2S_y = .105$ BY INSPECTION

$2\sigma_y = .33$ BY INSPECTION

$$r^2 = 1 - \frac{S_y}{\sigma_y} = 1 - \frac{.105}{.33} = .683 \quad r = \underline{.83}$$

ESTIMATING EQUATION

LET $X_1 = 7.0$ THEN $Y_1 = 4.19$

LET $X_2 = 9.0$ THEN $Y_2 = 4.92$

$$Y - Y_1 = \frac{Y_1 - Y_2}{X_1 - X_2}(X - X_1)$$

$$Y - 4.19 = \frac{.73X}{2} - \frac{.73}{2} \times 9.0$$

$$\underline{Y = .365X + .71}$$

95% CONFIDENCE LIMITS

$$Y = aX + b \pm 2S_y$$

$a = .365 \quad b = .71$

UPPER LIMIT $\underline{Y = .365X + .815}$

LOWER LIMIT $\underline{Y = .365X + .605}$

TEST OF SIGNIFICANCE

$$F = \frac{(N-2)r^2}{1-r^2}$$

$$F = \frac{48 \times .683}{.317} = \underline{105}$$

Figure 2-10. Sample Calculations Using Approximate Method

TABLE 2-4. PLATE CURRENT VS. TIME (non-linear correlation)

Tube No.	Y	X	Tube No.	Y	X
1	40.0	427	8	59.1	376
2	99.3	333	9	112.7	324
3	72.4	344	10	50.2	376
4	44.3	384	11	57.0	356
5	43.9	375	12	73.2	342
6	98.0	343	13	56.0	376
7	47.6	406	14	76.5	356
Y = Plate Current (Microamperes)			X = Time (Milliseconds)		

make a scatter plot of the data. Figure 2-11 represents a plot of the data tabulated in Table 2-4.

2.2.26 It is observed that the plot seems to indicate a curved tendency. The logarithms of the variables, tabulated in Table 2-5, are plotted as shown in Figure 2-12. A better approximation of a linear relationship is observed, indicating that a better simple correlation exists between the logarithms of the variables than between the variables themselves. The transformation of Y_1 = Log Y and X_1 = Log X is made and the procedure outlined for simple linear correlation is followed as outlined in Figure 2-13.

2.2.27 Either the computation by deviation or the approximate method can be used after this transformation is made. The procedure for determining the confidence limits, line of estimation, coefficient of correlation and the circuit performance limits is the same as that used for simple correlation. It must be remembered, however, that the correlation is between the logarithms of the variables and when the limits are established, in terms of the variables, the transformation must be taken into account. In the example, the estimating equation is Log Y = 3.855 Log X + 11.676 and the coefficient of correlation, (r), is -.897. The negative sign indicates that as plate current increases, time decreases. This is an example of negative correlation.

2.2.28 Occasions will present themselves where a plot of one variable against the logarithm of the other variable will render a more nearly linear plot. In this case, the Log transformation is applied to only the appropriate variable.

2.2.29 MULTIPLE AND PARTIAL CORRELATION. There are instances when circuit performance depends on two or more tube characteristics to about the same degree. A fair degree of correlation may be observed between circuit performance and each tube characteristic separately. However, better correlation can sometimes be obtained by considering the combined effects of the tube characteristics and determining if multiple or partial correlation exists. Multiple correlation considers the combined effects of two or more independent variables. Partial correlation determines the effects of each variable separately if the other independent variable is maintained constant at some average value.

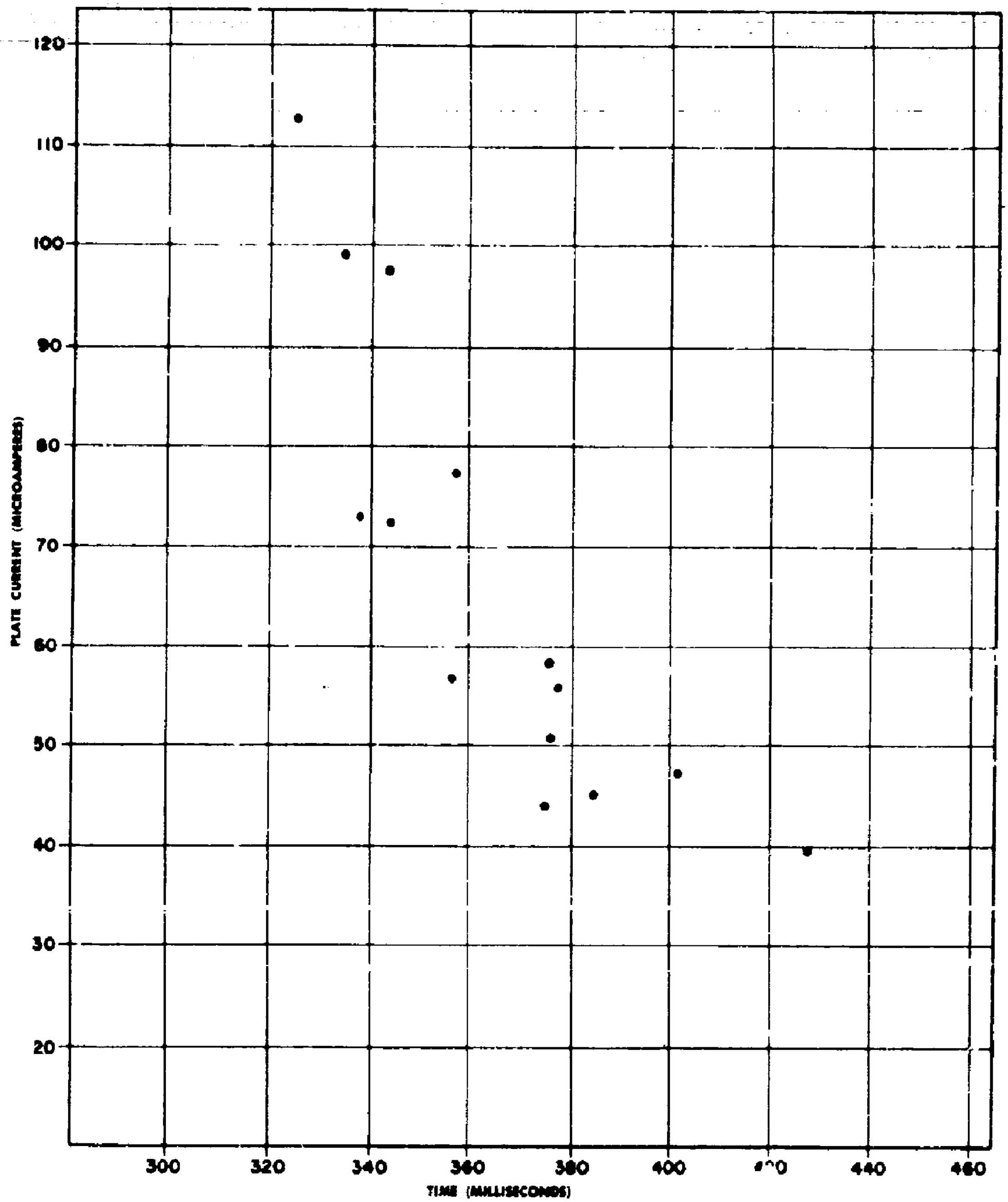


Figure 2-11. Typical Scatter Plot Showing Tendency Toward Non-Linear Relationship

TABLE 2-5

PLATE CURRENT VS. TIME AND THE LOGARITHMIC TRANSFORMATION

Tube No.	Y	X	Y_1 (LOG Y)	X_1 (LOG X)	Y_1^2	X_1^2	$(X_1 \cdot Y_1)$
1	40.0	427	1.60206	2.63043	2.56660	6.91916	4.21411
2	99.3	333	1.99695	2.52244	3.08781	6.36270	5.03719
3	72.4	344	1.85974	2.53656	3.45863	6.43414	4.71734
4	44.3	384	1.64640	2.58433	2.71063	6.67876	4.25484
5	43.9	375	1.64246	2.57403	2.69767	6.62563	4.22774
6	98.0	343	1.99123	2.53529	3.96500	6.42270	5.04835
7	47.6	406	1.67761	2.60853	2.81438	6.80443	4.37610
8	59.1	379	1.77159	2.57864	3.13853	6.64938	4.56829
9	112.7	324	2.05192	2.51055	4.21038	6.30286	5.15145
10	50.2	376	1.70070	2.57519	2.89238	6.63160	4.37963
11	57.0	356	1.75587	2.55145	3.08308	6.50990	4.48001
12	73.2	342	1.86451	2.53403	3.47640	6.42131	4.72472
13	56.0	376	1.74819	2.57519	3.05617	6.63160	4.50192
14	76.5	356	1.88366	2.55145	3.54817	6.50990	4.80606
TOTAL			25.19289	35.86811	45.60583	91.90907	64.48775
MEAN			1.799492	2.562008			

Y = Plate Current (Microamperes) X = Time (Milliseconds)

2.2.30 A second approach to the problem is through an analysis of variance to determine the relative effects of various tube properties on circuit performance. The procedure is somewhat complicated so will not be discussed here. For further discussion of correlation and the analysis of variance, the reader is referred to one of the statistical texts in the list of references at the end of this section.

STATISTICAL REFERENCES

Brownlee, K.A., Industrial Experimentation, New York, Brooklyn Chemical Publishing Co., 1949

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Fisher, R.A., Statistical Methods for Research Workers, New York, Hafner Publishing Company, 11th edition, 1950

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Hoel, P.G., Introduction to Mathematical Statistics, New York, Wiley and Sons, 1947

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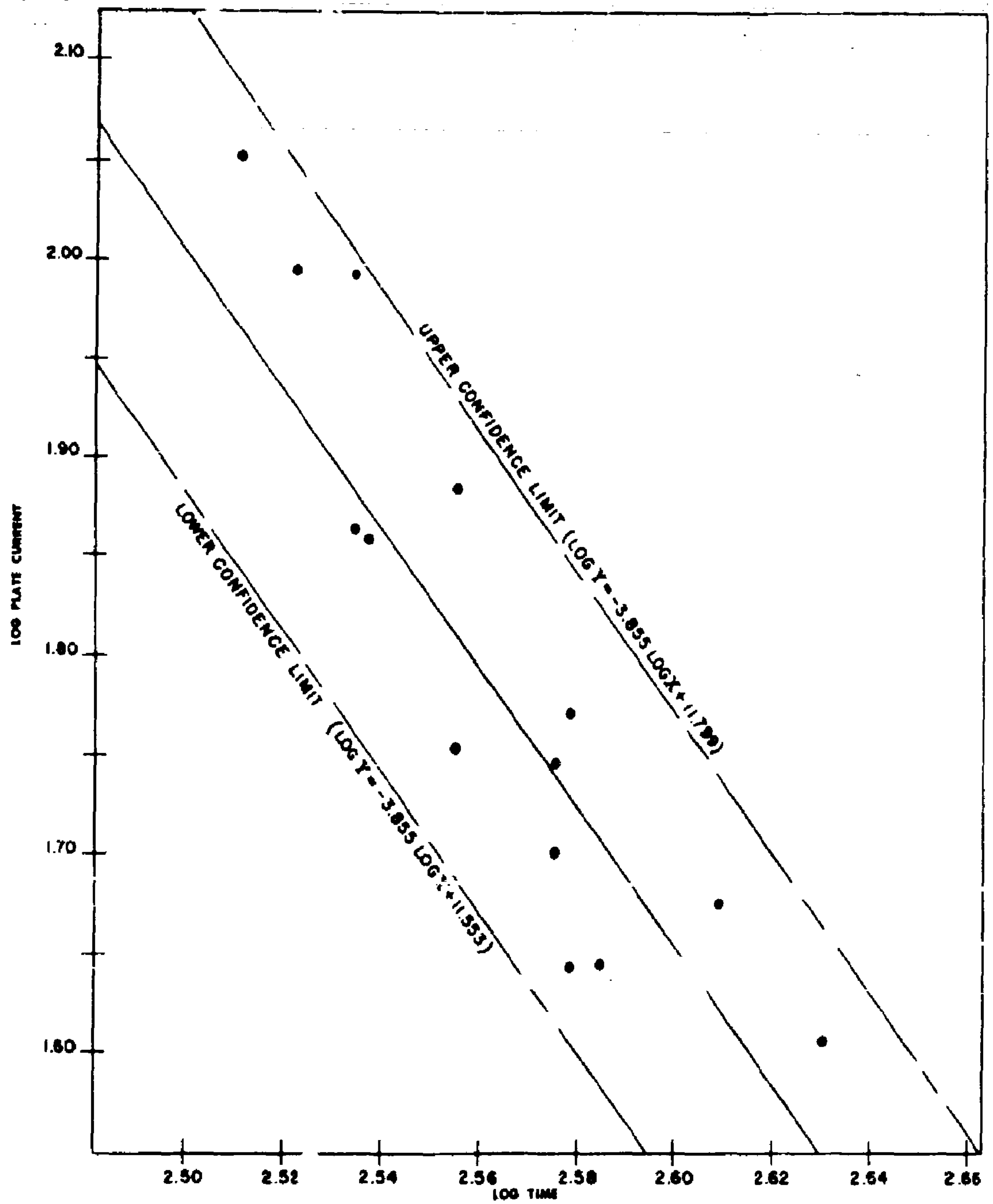

Figure 2-12. Example of the Use of Logarithmic Coordinates to Determine Correlation of a Non-Linear Relationship

COEFFICIENT OF CORRELATION

$$r^2 = \frac{(\Sigma x_1 y_1)^2}{\Sigma x_1^2 \Sigma y_1^2} = \frac{(-0.05663)^2}{0.27143 \times 0.01469} = .8045$$

$$r = -\underline{.897}$$

ESTIMATING EQUATION

$$Y_1 = \text{LOG } Y \qquad X_1 = \text{LOG } X$$

$$Y_1 = aX_1 + b \quad \text{OR} \quad \text{LOG } Y = a \text{ LOG } X + b$$

$$a = \frac{\Sigma x_1 y_1}{\Sigma x_1^2} = -\frac{0.05663}{0.01469} = -3.855$$

$$b = \bar{Y}_1 - a\bar{X}_1 = 1.799492 - (-3.8550)(2.562008) = 11.676$$

$$\underline{\underline{\text{LOG } Y = -3.855 \text{ LOG } X + 11.676}}$$

TEST OF SIGNIFICANCE

$$F = \frac{(N-2)r^2}{1-r^2} = \frac{12 \times .8045}{1-.8045} = \underline{49.5}$$

Figure 2-13. Sample Calculations for Non-Linear Correlation

SECTION 3

DETERMINING CIRCUIT TOLERATION TOWARD DETRIMENTAL PROPERTIES

2.3 GENERAL.

2.3.1 Detriments are inherent tube properties which must be considered in circuit design on the basis of their detrimental effects on circuit operation. Two questions arise concerning tube detriments in circuit design calculations:

a. What value of each tube detriment will still allow satisfactory operation?

b. Does the applicable MIL-E-1 Specification for the tube type tentatively selected adequately define detriments?

2.3.2 The use of too few randomly selected tubes to check circuit toleration of tube detriments nearly always leads to an overly optimistic conclusion. The use of many "limit tubes" or the simulation of the detriment limit gives a more realistic picture of tube-circuit compatibility.

2.3.3 In considering the effects of tube detriments upon circuit performance, it must be understood that any application predicated on the existence of a detriment is inherently unreliable, since by definition the detriment may or may not be possessed by an individual tube. Consideration regarding detriments can only be on the basis of the limit the detriment can reach before the performance of the circuit is impaired. It, therefore, becomes necessary for the circuit designer to determine the permissible limit for those detriments which affect the performance of the circuit being designed. The following methods may be used to determine the compatibility of tube detriments with required circuit performance.

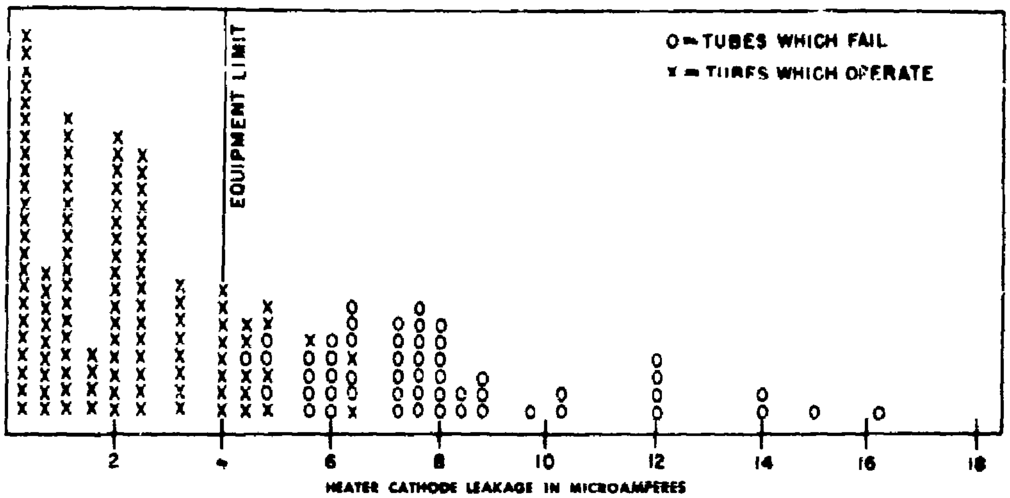

Figure 2-14. Typical Plot Showing Permissible Limit on Heater-Cathode Leakage

2.3.4 CIRCUIT ATTRIBUTES METHOD.

2.3.5 One method is to test in the circuit a number of tubes which possess the detriment in question in varying degrees and to note those tubes which perform satisfactorily and those which do not. A plot, similar to Figure 2-14, can then be made which presents those tubes which fail, apart from those that operate satisfactorily. This figure shows a plot of tubes grouped according to heater-cathode leakage current. It is observed that tubes begin to fail in the equipment when the heater-cathode leakage is greater than four microamperes. This means that in order for the circuit engineer to design with confidence, he must be sure that the specification limit on heater-cathode leakage is less than four microamperes. He must be sure, moreover, that the life-test end point on heater-cathode leakage is less than four microamperes.

2.3.6 Four microamperes, therefore, represents the limit of heater-cathode leakage that the equipment will tolerate. The tube specification limit must be less than four microamperes or a more tolerant circuit must be designed.

2.3.7 CIRCUIT VARIABLES METHOD.

2.3.8 The previous example assumes that, dependent upon the amount of heater-cathode leakage present, the tube either operates or does not operate in the circuit. Often the problem is not so clear-cut as this; rather a degrading effect on perform-

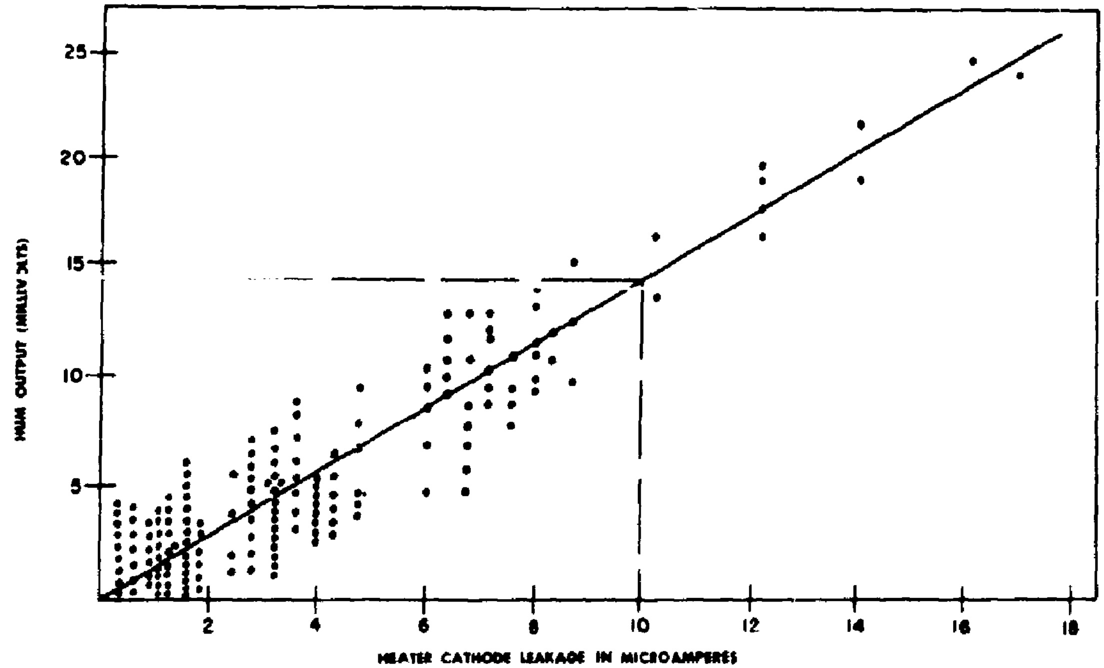

Figure 2-15. Method of Determining Limit on Heater-Cathode Leakage vs Hum Output

ance is experienced and the design engineer has to decide how good is "good enough", or where to establish the limit of satisfactory circuit performance.

2.3.9 Figure 2-15 indicates an approach to this problem. Suppose that hum output as a result of heater-cathode leakage is used to evaluate the performance of a circuit. A point-by-point plot is made of hum output against heater-cathode leakage. Suppose 15 millivolts is established as the maximum limit for hum output; the limit on heater-cathode leakage should be less than 10 microamperes to assure satisfactory operation.

PART III

APPLICATION INFORMATION AND SPECIFICATION ASSURANCE

3. GENERAL.

3.01 Parts I and II of this report outline general tube properties and methods of treating them in circuit design. Part III presents information on specific tube types which appear in the following military standard published by the Armed Services Electro Standards Agency.

3.02 MILITARY STANDARD MIL-STD-200C.

3.03 MIL-STD-200C presents a list of preferred electron tube types that have been chosen jointly by the Departments of the Army, the Navy, and the Air Force to fulfill the majority of electron tube applications. The purposes of this standard are two-fold:

a. To guide military equipment designers and manufacturers in the choice of tube types that represent the highest quality tubes available for military use.

b. To provide for a minimum tube maintenance stock by making extensive use of a minimum number of tube types.

3.04 The current list is included here as Table 3-2 for information purposes. Reference to the most recent issue of MIL-STD-200 should always be made since it is subject to revision and reissue. Specification data applicable to the receiving types of this standard are presented in Table 3-3 which includes a summary of specification controls and a list of properties tested by variables.

3.05 SPECIFICATIONS MIL-E-1.

3.06 In the MIL-E-1 specifications, effort has been made to provide assurance that the equipment designer using these electron tube types can expect comparatively uniform initial characteristics, relatively stable characteristics throughout life, and a high attribute quality level. Under conditions of operation incompatible with the test conditions and ratings set forth in the specifications, no assurance of satisfactory operation exists. Both the quiescent operating point and the dynamic operating requirements must be considered in relation to these ratings.

3.07 APPLICATIONS.

3.08 The following sections on the application of triodes, pentodes, and others, consider each of the ratings applicable to the individual category.

TABLE 3-1. CIRCUIT DESIGNERS' CHECK LIST

R..TINGS--Does the operation of the tube approach any absolute rating under any usual condition of supply-voltage variation, load variation, or manufacturing variation in the equipment itself?

Heater Voltage	Max.	Min. . . . .
Anode Voltage (dc)	Max.	
(peak forward)	Max.	
(peak inverse)	Max.	
Screen Grid Voltage	Max.	
Control Grid Voltage	Max.	Min. . . . .
Heater-Cathode Voltage	Max	
Control Grid Resistance	Max.	
Cathode Current (average)	Max.	Min. . . . .
(peak)	Max.	
Anode Dissipation	Max.	
Screen Grid Dissipation	Max.	
Bulb Temperature	Max.	

CHARACTERISTICS--Does the specification of the tube type selected define the required characteristics? Will the circuit operate satisfactorily with tubes having the range of characteristics allowable in the specification?

Transconductance (life-test end point)	Max.	Min. . . . .
Transconductance (at reduced heater voltage)	Max.	Min. . . . .
Plate Current (life-test end point)	Max.	Min. . . . .
Screen Grid Current	Max.	Min. . . . .
Heater Current	Max.	Min. . . . .
Interelectrode Capacitance	Max.	Min. . . . .
Dynamic Plate Resistance	Max.	Min. . . . .
Amplification Factor	Max.	Min. . . . .
Power Output (life-test end point)	Max.	Min. . . . .

DETRIMENTS--Does the specification of the tube type selected adequately define detriments? Will the circuit operate satisfactorily with tubes having the detriment value allowable in the specification?

Electrode Insulation (life-test end point)		Min. . . . .
Grid Current at Rated E_f (life-test end point)	Max.	
Grid Current at Elevated E_f (life-test end point)	Max.	
Plate Current Cutoff	Max.	Min. . . . .
Heater-Cathode Leakage	Max.	
RF Noise, AF Noise, Noise and Microphonics	Max.	
Change of Characteristics with Life (I_b, P_o, S_m)	Max.	
Change of Characteristics with Heater Voltage	Max.	

BASIC LIMITATIONS--Is operation of the circuit satisfactory considering the basic limitations of electron tubes? Does circuit function depend upon any unspecified property of the tube?

Initial-Velocity-Electron Current
Spurious Emission Current
"Interface Resistance" Effect
Thermionic Instability
Electron Coupling Effects

TABLE 3-2. RECEIVING TUBES OF MIL-STD-200C

Structure		1.25 and 1.4 (volts)	5.0 (volts)	6.3 (volts)	
Diodes		#1A3		2B22 *5647 #5726/6AL5W	*5829WA #*5896
Triodes				#2C40 #6C4W *5703WA	#*5718 #*5719 *5744WA *6533
Twin Triodes		#3A5		#12AT7WA #5670 #5751 #5814A	*6021 *6111 *6112
Pentodes	Remote			#5749/6BA6W #*5899	
	Sharp	#*1AD4 *1AH4		#6AH6 #6AU6WA #5654/6AK5W	*5702WA #*5840
Mixers and Converters				*5636 #5725/6AS6W	#5750/6BE6W *5784WA
Power Output	Pen-todes	#3B4 3V4 #*5672 #*6088		#2E30 6AG7 6BG6G #6L6WGB	5686 #*5902 #6005/6AQ5W #*5639, 6094
	Triodes			#5687	6080WA
Rectifiers		#1B3GT #1Z2	#5R4WGA #5Y3WGTA	#6X4W #*5641	6203

\# Also U. S. tubes on NATO priority list of electron tubes (values).

* Subminiature

TABLE 3-3 NUMERICAL LISTING OF RECEIVING TUBES OF MIL-STD-200C PER 5 OCTOBER 1955

Tube Type JAN-	Specification Serial Number	Specification Sheet Dated	Method of Defining Distribution of Characteristics	Characteristics Specified By Variables	Characteristics Specified During Life
1A3	MIL-E-1/19	5 Feb 1953	M - M		Io
•1AD4	MIL-E-1/20A	9 July 1953	M - M		Sm2
•1AH4	MIL-E-1/316	14 Aug 1953	M - M		Sm1, Ic1
1B3GT	MIL-E-1/74[illegible]	23 Dec 1955	M - M		Is
1Z2	MIL-E-1/29	5 Feb 1953	M - M		Is
2B22	MIL-E-1/736	17 Dec 1954	M - M		Etd
2C40	MIL-E-1/737	17 Dec 1954	M - M		Po
2E30	MIL-E-1/32	5 Feb 1953	M - M		Δ_{Ef}Ip, Ic2
3A5	MIL-E-1/33A	14 Jan 1954	M - M		Sm
3B4	MIL-E-1/34B	17 Dec 1954	M - M		Δ_{Ef}Ep, Ic2, ep
3V4	MIL-E-1/343	14 Aug 1953	M - M		Po1
5R4WGA	MIL-E-1/116A	4 March 1954	M - M		Io2
5Y3WGTA	MIL-E-1/44A	14 Jan 1954	M - M		Io
6AG7	MIL-E-1/45B	23 Aug 1955	M - M		Po
6AH6	MIL-E-1/46	5 Feb 1953	M - M		Sm1
6AU6WA	MIL-E-1/1	13 Jan 1953	M-LRLM-URLM-M	If, #Ihk, #Ic1, Ib1, Ic2, Sm1, #Sm2, #Cg1p, Cin, Cout, #Ep	Rg1-all, Rp-all, If, Ihk, Ic1, Sm1, ΔAvg Sm1
6BG6G	MIL-E-1/53A	14 Jan 1954	M - M		Is
6C4W	MIL-E-1/55B	14 Jan 1954	M - M		Sm1, Ic
6L6WGB	MIL-E-1/197	20 May 1953	M - M		Po, Sm
6X4W	MIL-E-1/64A	20 May 1953	M - M		Io
12AT7WA	MIL-E-1/3	13 Jan 1953	M-LRLM-URLM-M	If, #Ihk, #Ic, Ib1, Sm1, #Sm2	Rg-all, Rp-all, If, Ihk, Ic, Sm1, ΔAvg Sm1
•5636	MIL-E-1/168C	23 June 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm1	Ic1, If, Δ_tSm1, Δ_{Ef}Sm1, Ihk, Rp-all, Rg-all, AvgΔ_tSm1

* Subminiature tube

\# Refers to asymmetric limits

TABLE 3-3. NUMERICAL LISTING OF RECEIVING TUBES OF MIL-STD-200C PER 5 OCTOBER 1955 (CONT.)

RECEIVING TUBES OF MIL-STD-200C
DATED 5 OCTOBER 1955

Tube Type JAN-	Specification Serial Number	Specification Sheet Dated	Method of Defining Distribution of Characteristics	Characteristics Specified By Variables	Characteristics Specified During Life
*5639	MIL-E-1/1c3C	23 June 1955	M-LAL-UAL-M-ALD	If	Ic 1, If, Δ_tSm1, Δ_{Ef}Sm, Ihk, Rp-all, Rg-all, AvgΔ_tSm1
*5641	MIL-E-1/170A	26 Oct 1954	M-LAL-UAL-M-ALD	If	If, Ihk, Io
*5647	MIL-E-1/204B	23 June 1955	M-LAL-UAL-ALD	If	If, Io, Δ_tIo, Ihk, Rp-all
5654/ 6AK5W	MIL-E-1/4A	5 Dec 1955	M-LAL-UAL-M-ALD	If, Ib 1, Sm 1, Ic2, #Sm2, Cin, Cout	Rg-all, Rp-all, If Ihk, Ic 1, Sm 1, AvgΔSm1, Δ_tSm, Δ_{Ef}Sm
5670	MIL-E-1/5A	5 Dec 1955	M-LAL-UAL-M-ALD	If, Ib 1, Sm 1, Mu	If, Ihk, Ic, Δ_{Ef}Sm, Sm1, AvgΔSm1, Δ_tSm1, Rg-all, Rp-all
*5672	MIL-E-1/280	9 July 1953	M - M		Po 1, Ic 1
5686	MIL-E-1/171	20 May 1953	M - M		Po 1, Ic
5687	MIL-E-1/80B	16 July 1954	M - M		Ib 1, Sm
*5702WA	MIL-E-1/82A	28 Oct 1953	M-LAL-UAL-M-ALD	Ib 1, Sm 1, Ic 2	If, Ihk, Ic, Sm 1, Δ_tSm1, Δ_{Ef}Sm, Rg-all, Rp-all
*5703WA	MIL-E-1/293A	16 July 1954	M-LAL-UAL-M-ALD	Ib 1, Sm 1	If, Ihk, Ic Ic2 Δ_tSm1 Δ_{Ef}Sm, Rg-all, Rp-all
*5718	MIL-E-172B	5 Aug 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm 1	Ic, If, Δ_tSm1, Δ_{Ef}Sm1, Ihk, Rg-all, Rp-all, AvgΔ_tSm1
*5719	MIL-E-1/173C	5 Aug 1955	M-LAL-UAL-M-ALD	If, Sm 1	Ic, If, Δ_tSm1, Δ_{Ef}Sm1, Ihk, Rg-all, Rp-all, AvgΔ_tSm1

* Subminiature tube

\# Refers to asymmetric limits

TABLE 3-3. NUMERICAL LISTING OF RECEIVING TUBES OF MIL-STD-200C PER 5 OCTOBER 1955 (CONT.)

Tube Type JAN-	Specification Serial Number	Specification Sheet Dated	Method of Defining Distribution of Characteristics	Characteristics Specified By Variables	Characteristics Specified During Life
5725/ 6AS6W	MIL-E-1/6B	5 Dec 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm1	Rg1-all, Rg3-all, Rp-all, If, Ihk, Ic1, Sm1, AvgΔSm1, Δ_tSm1, Δ_{Ef}Sm1
5726/ 6AL5W	MIL-E-1/7A	3 May 1954	M-LRLM-URLM-M	If, #Ihk, #Io, #Is, #C (1p to 2p), C(1p to H + 1k + sds.), C(2P to h + 2k + sds.), C(1k to h + 1p + sds.), C(2k to h + 2p + sds.) #Ep	Rp-all, If, Ihk, Io
*5744WA	MIL-E-1/84B	16 July 1954	M-LAL-UAL-M-ALD	Ib1, Sm1, Mu	If, Ihk, Ic1, Ic2, Δ_tSm1, Δ_{Ef}Sm1, Rg-all, Rp-all
5749/ 6BA6W	MIL-E-1/8	13 Jan 1953	M-LRLM-URLM-M	If, #Ihk, #Ic1, Ib, Sm1, #Ic2, #Sm2, Sm3, #Ep	Rg1-all, Rp-all, If, Ihk, Ic1, Sm1, AvgΔSm1,
5750/ 6BE6W	MIL-E-1/9	13 Jan 1953	M-LRLM-URLM-M	If, #Ihk, #Ic3, Sc1, Ic1, Ib2, #Ic2+4, Ik, Sm1, #Sm2, #Ep	Rg1-all, Rg3-all, Rp-all, If, Ihk, Ic3, Sc1, Ic1, ΔAvg Sc1
5751	MIL-E-1/10	13 Jan 1953	M-LRLM-URLM-M	If, #Ihk, #Ic, Ib1, #Ep (ac ampli.), #Ib2, Sm1, #Sm2, Mu, Cgp, Cin, C1out, C2out, #Ep	Rg-all, Rp-all, If, Ihk, Ic, ACA, ΔAvg ACA
*5784WA	MIL-E-1/88B	23 Aug 1955	M-LAL-UAL-M-ALD	Ib1, Sm1	If, Ihk, Ic1, Δ_tSm1, Δ_{Ef}Sm1, Rg1-all, Rg3-all, Rp-all
5814A	MIL-E-1/12A	23 Dec 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm1, Mu	Rg-all, Rp-all, If, Ihk, Ic1, Sm1, AvgΔSm1, Δ_tSm1, Δ_{Ef}Sm1

* Subminiature
\# Refers to asymmetric limits

TABLE 3-3. NUMERICAL LISTING OF RECEIVING TUBES OF MIL-STD-200C PER 5 OCTOBER 1955 (CONT.)

Tube Type JAN-	Specification Serial Number	Specification Sheet Dated	Method of Defining Distribution of Characteristics	Characteristics Specified By Variables	Characteristics Specified During Life
*5629WA	MIL-E-1/292A	23 Dec 1955	M-LAL-UAL-M-ALD	#Io, #Is	Rp-all, If, Ihk, Io, Δ_t Io
*5840	MIL-E-1/140B	5 Aug 1955	M-LAL-UAL-ALD	If, Ib1, Sm1	Ic1, If, Δ_t Sm1, Δ_{Ef} Sm1, Ihk, Rg-all, Rp-all, Avg Δ_t Sual
*5896	MIL-E-1/174C	23 June 1955	M-LAL-UAL-M-ALD	If	If, Io, Δ Io, Ihk, Rp-all
*5899	MIL-E-1/97C	23 June 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm1	Ic1, If, Δ_t Sm1, Δ_{Ef} Sm, Ihk, Rp-all, Rg-all, Avg Δ_t Sm1
*5902	MIL-E-1/175B	26 Oct 1954	M-LAL-UAL-M-ALD	If, Ib1, Sm	If, Ihk, Ic1, Δ_t Pol, Avg Δ Pol, Rp-all, Rg-all, Δ_{Ef} Pol
6005/6AQ5W	MIL-E-1/13A	20 M[illegible] 1953	M-LRLM-URLM-M	If, #Ihk, #Ic1, #Ic2, #Po1, Ib, #Po2, #Cglp, Cin Cout	If, Ihk, Ic1, Pol, Δ Avg Pol
*6021	MIL-E-1/188B	23 Aug 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm1	If, Ihk, Ic, Δ_t Sm1, Avg Δ_t Sm1, Rg-all, Rp-all, Δ_{Ef} Sm1
6080WA	MIL-E-1/510B	5 Dec 1955	M-LAL-UAL-M-ALD	Ib1, Sm1	Ic, Δ_{Ef} Sm, Ihk, If, Sm, Rg-all, Rp-all
*6088	MIL-E-1/694	3 May 1954	M - M		Pol
6094	MIL-E-1/821B	23 Dec 1955	M-LAL-UAL-M-ALD	Ib, #Ic2, #Po, Sm	If, Ic1, Po, Δ_{Ef} Po, Ihk, Rg1-all, Rp-all, Avg Δ_t Po

* Subminiature

\# Refers to asymmetric limits

TABLE 3-3. NUMERICAL LISTING OF RECEIVING TUBES OF MIL-STD-200C PER OCTOBER 1955 (CONT.)

Tube Type JAN-	Specification Serial Number	Specification Sheet Dated	Method of Defining Distribution of Characteristics	Characteristics Specified By Variables	Characteristics Specified During Life
*6111	MIL-E-1/189B	23 Aug 1955	M-LAL-UAL-M-ALD	If, Ib1, Sm1	If, Ihk, Ic, Δ_tSm1, AvgΔSm1, Rg1-all, Rp-all, Δ_{Ef}Sm1
*6112	MIL-E-1/190B	5 Aug 1955	M-LAL-UAL-M-ALD	If, Sm1	Ic, If, Δ_tSm1, Δ_{Ef}Sm1, Ihk, Rg-all, Rp-all, AvgΔ_tSm1
6203	MIL-E-1/262A	23 June 1955	M-LAL-UAL-M-ALD	If	Δ_tIb, If, Ihk
6533	MIL-E-1/975	5 Dec 1955	M-LAL-UAL-M-ALD	If, Sm	If, Ihk, Ic, Δ_tSm, AvgΔ_tSm, Rg-all, Rp-all, Δ_{Ef}Sm

* Subminiature

\# Refers to asymmetric limits

SECTION 1

APPLICATION OF TRIODES

3.1 TRIODE PROPERTIES.

3.1.1 This section discusses triode properties and methods of treating them in circuit design. Triode types are shown on a field of constant Mu lines for comparison purposes in Figures 3-1 and 3-2. The test conditions under which these characteristics were determined are those listed in the applicable specifications. Tube properties under actual usage may vary considerably from the values shown. The conditions under which the acceptance tests are performed for various triodes are given with other information in the section on specific tube types where a treatment of acceptance limits, characteristic variability, and permissible areas of operation appears.

3.1.2 PERMISSIBLE OPERATING CONDITIONS. The permissible operating conditions are considered in relation to the ratings. In general, as the operating condition approaches the ratings, the reliability of the design will be adversely affected, since these define the limiting conditions beyond which there is a complete absence of operating assurance.[1/] Figure 3-3, an average plate characteristic plot for a typical triode, shows such a permissible area of operation bounded by heavy lines representative of the absolute maximum ratings of the type.

3.1.3 QUESTIONABLE AREAS OF OPERATION. Note should be taken of Regions 1 and 2 indicated by line shading. Though operation in these regions is permissible it is nonetheless questionable for certain applications. Region 1 is located near the zero bias line. Tube characteristics in this region are subject to considerable variability primarily due to grid currents resulting from such causes as contact potential and ionic gas currents. These properties are rarely subject to complete specification control and are therefore unpredictable; as a result, tube characteristics in this region may vary more widely than is indicated by the specification limits. Grid currents may, in addition, cause loading of the input circuit, resulting in wide variation of apparent stage gain over short periods of time.

3.1.4 LOW CURRENT REGION. The second area (2) appears in the low plate current region of the tube. In some specifications, a minimum cathode current appears as a rating. Unless otherwise indicated on the individual electron tube specification sheets, operation below this rated value is decidedly uncertain since in this low current region, particularly under conditions of fixed bias, currents may vary widely from tube to tube or between sections in dual types. Furthermore, circuit operation is not assured when the tube, after being held at low or no plate current with its heater energized for an appreciable length of time, is subjected to higher current demands.

1/ Reference Table 1-3 in Part I

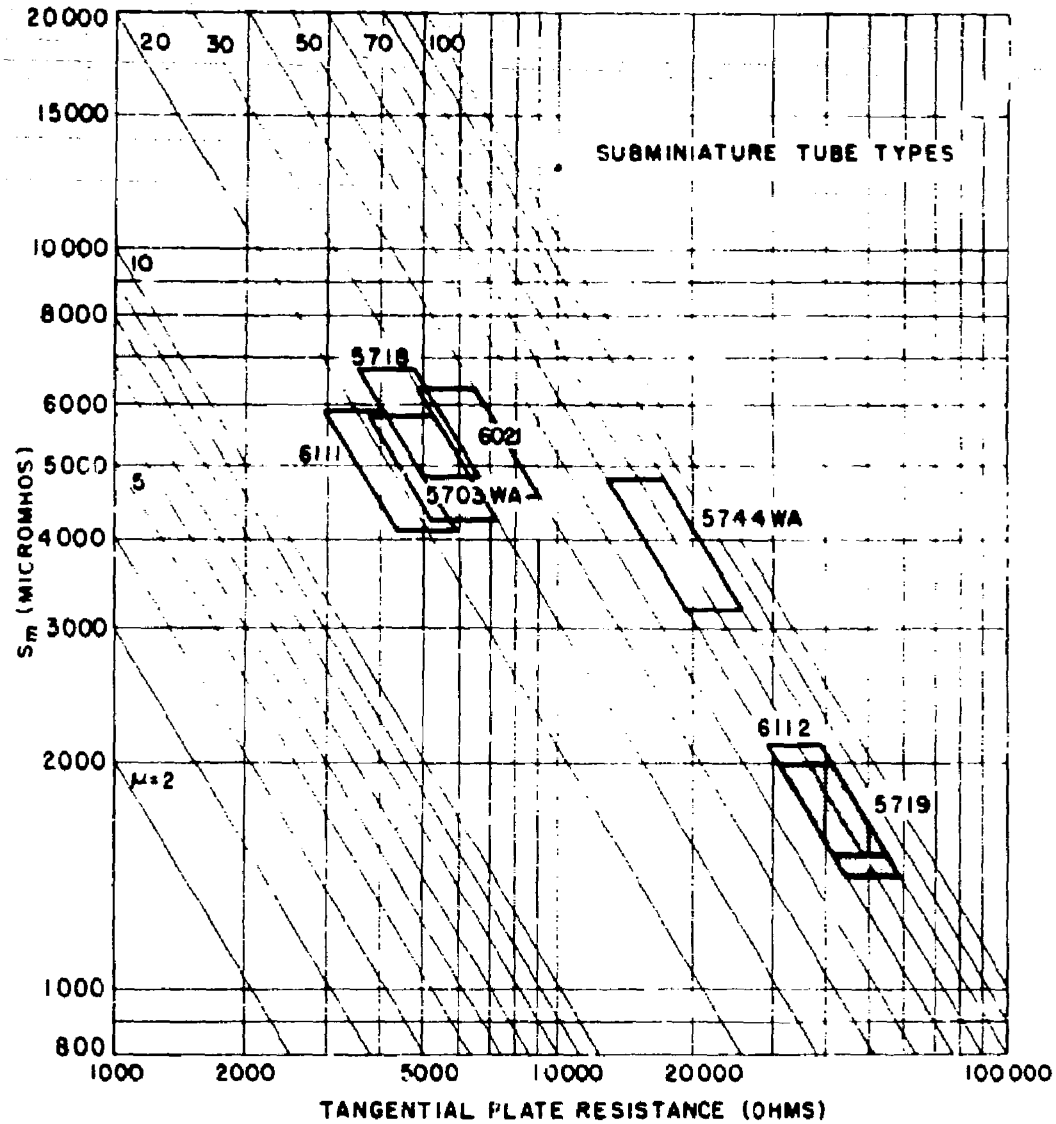

Figure 3-1. Triode Properties of Subminiature Type Tubes

3.1.5 AREA ADJACENT TO MAXIMUM PLATE DISSIPATION BOUNDARY OF PERMISSIBLE AREA OF OPERATION. The third (3) area deserving consideration is adjacent to the maximum plate dissipation boundary of the permissible area of operation. A definite relationship exists between the plate dissipation, the bulb temperature, and the effective environmental temperature. Under certain conditions, the maximum rated bulb temperature may be exceeded unless the plate dissipation is reduced. In many cases, the proper choice of shield, socket [1] and/or

[1] See WADC Report 53-174, June 1953

mounting clamp (subminiature) will materially aid in the solution of this particular problem.

3.1.6 OTHER DESIGN CONSIDERATIONS.

3.1.7 In addition to the limitations discussed above, other design considerations not immediately apparent from the specification are treated below for triode application.

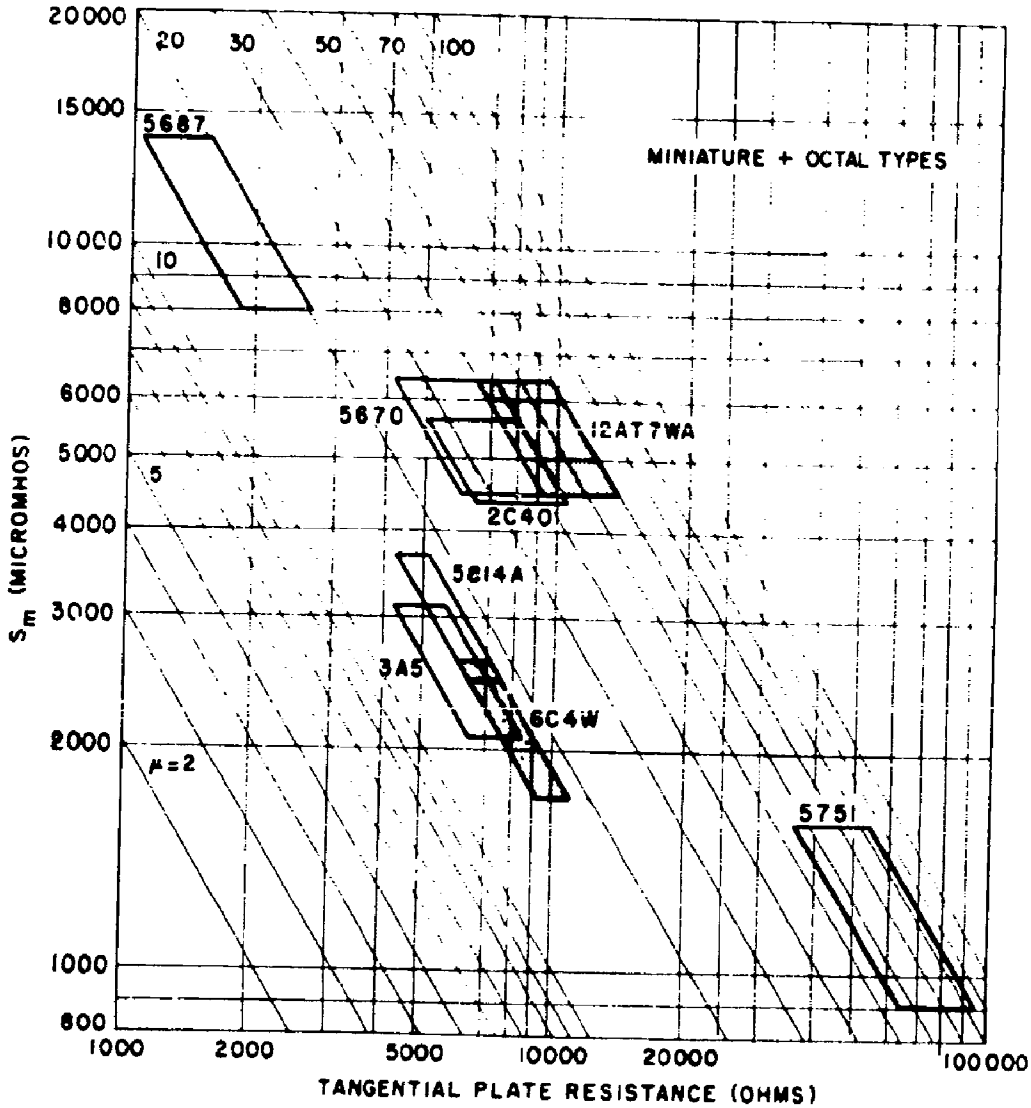

Figure 3-2. Triode Properties of Miniature and Octal Type Tubes

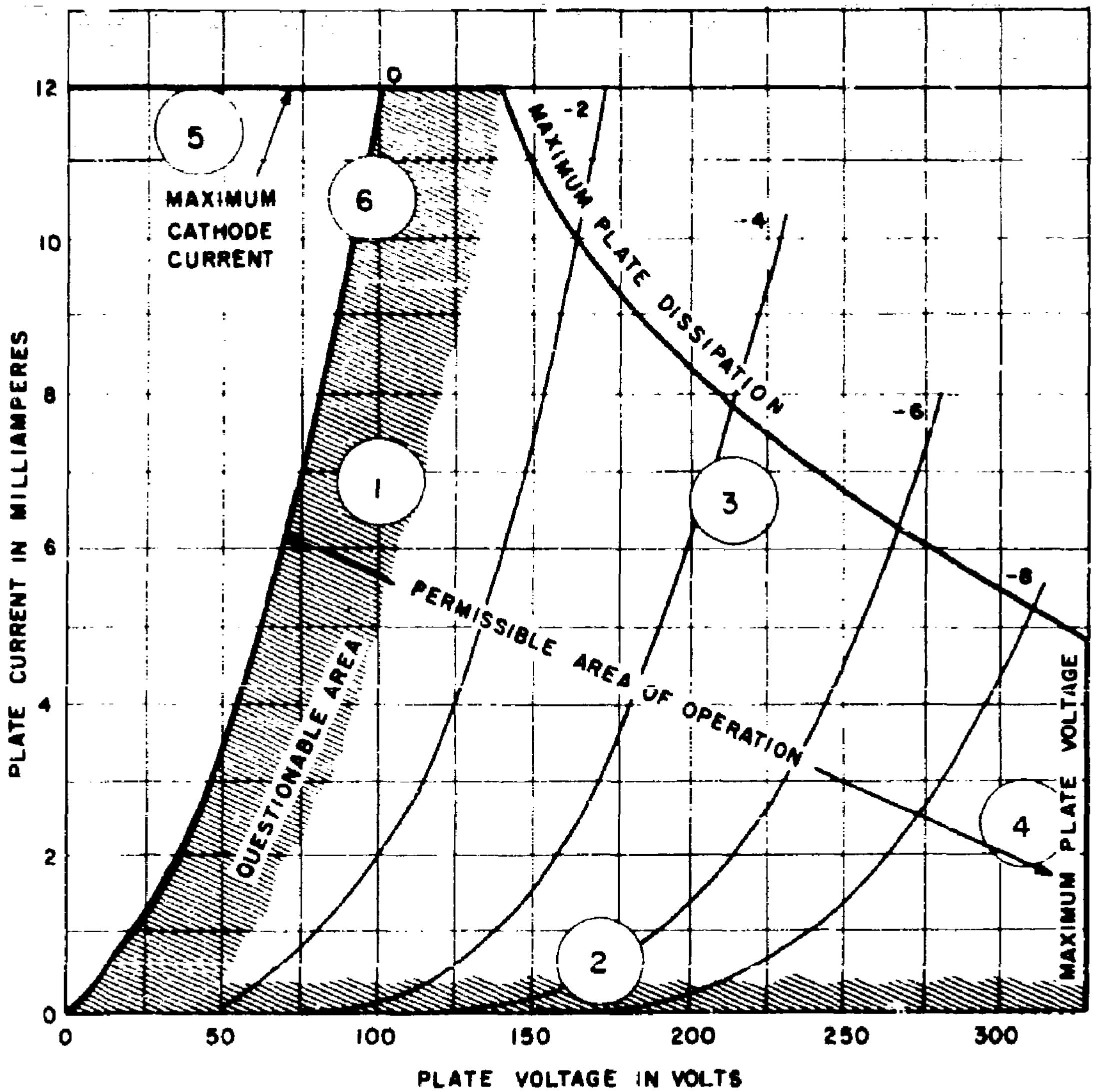

Figure 3-3. Plate Characteristic Plot for a Typical Triode

3.1.8 SUPPLY VOLTAGES. A note concerning the use of supply voltages in excess of the rated maximum appears in MIL-E-1, as follows: "Unless otherwise specified on the tube specification sheet, when the load impedance is of such type that the instantaneous voltage at the plate never exceeds the supply voltage, the supply voltage may be twice the maximum rated dc plate voltage, provided the maximum rated average dissipation is never exceeded on any electrode."

3.1.9 LOW ELECTRODE CURRENT. Unless otherwise noted in individual tube type sections, circuit operation is not assured when the tube, after being held at a low

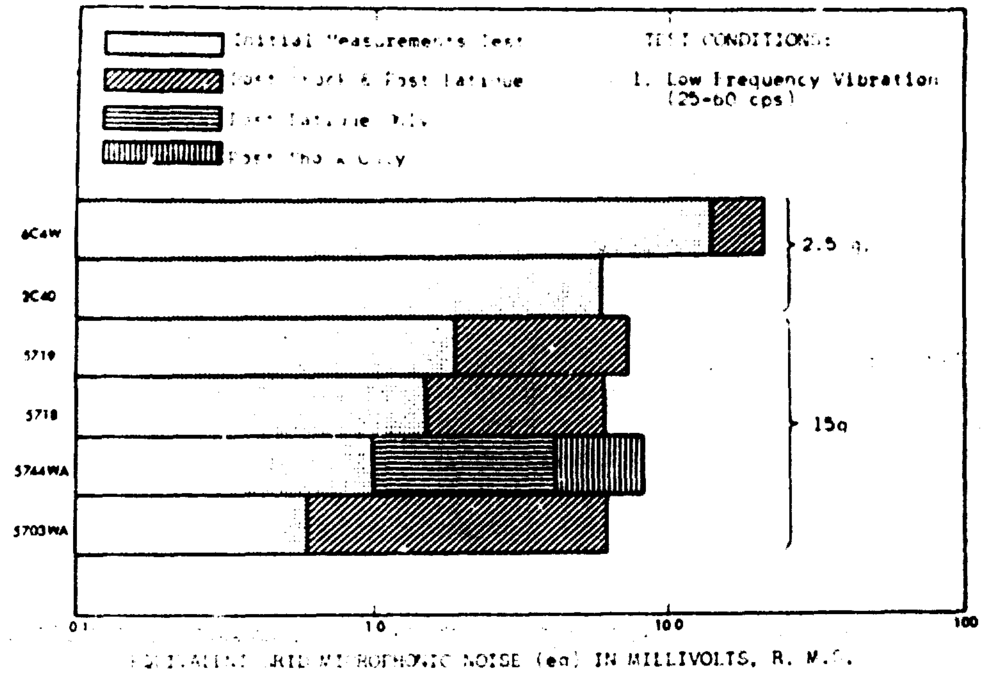

Figure 3-4. Equivalent Grid Microphonic Noise Limits for Single Triodes

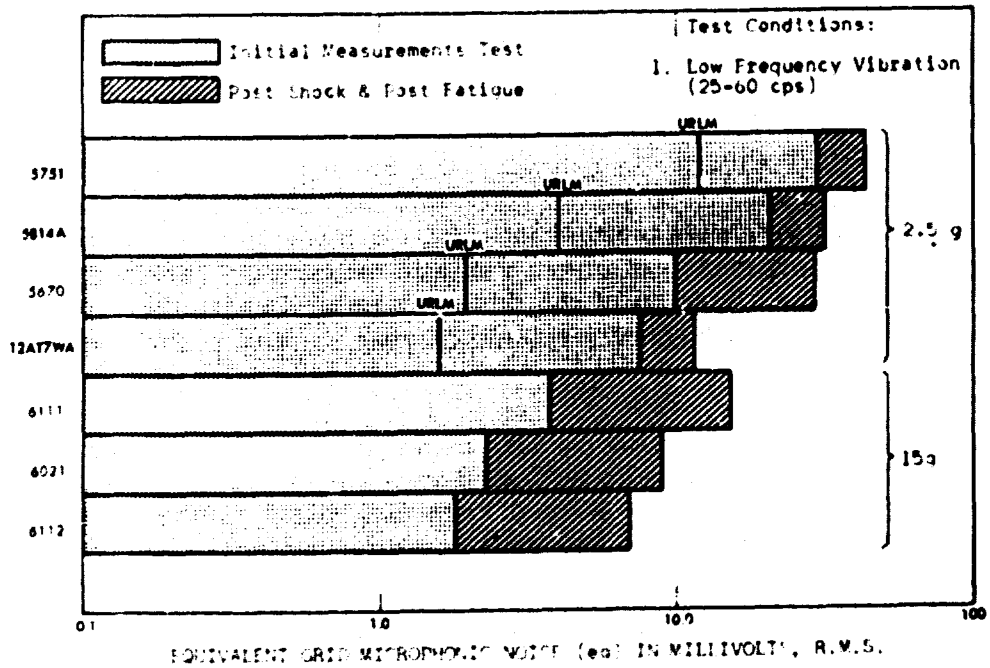

Figure 3-5. Equivalent Grid Microphonic Noise Limits for Dual Triodes

value of plate current for appreciable periods of time, is subjected to higher current demands. Examples of this service are all types of intermittent operation wherein heaters remain energized under conditions of very low or no plate current.

3.1.10 A-C PLATE OPERATION. Considerable caution should be exercised in the supplying of plate potential from alternating voltage sources. In such applications, the negative excursions of the plate afford an opportunity for electron emission from plate to control grid, resulting in a negative shift of bias. In addition, the positive alternating voltage peaks may draw cathode current sufficient to impair the operation of the tube.

3.1.11 HEATER OPERATION. Attention should be given to heater voltage tolerance ratings. Life and reliability of performance are directly related to the degree that heater voltage is maintained at center rated values. The importance of good heater voltage regulation on the useful life of the tube is evident from Table 1-3 (Part I). Here it is apparent that excessive heater voltage will hasten deterioration within almost every electron tube defect category.

3.1.12 BIAS CONDITIONS. The apparent variability of characteristics of many triode tube types, as reflected in the specification, is greatly reduced through the use of cathode bias for measurement test conditions. It can be expected, therefore, in applications employing fixed bias, that characteristic variability will exceed that which is evident for such types under MIL-E-1 test conditions.

3.1.13 GRID RETURN RESISTANCE. Caution should be exercised in the choice of grid return resistors. Specification assurance on life is lost if the resistance chosen has a value greater than that specified in the intermittent life test conditions.

3.1.14 PULSE OPERATION. In general, the testing of all electron tubes is performed at discreet operating points only and unless specific tests provide assurance of pulse behavior, no assumptions may be made for such conditions of operation. Specification assurance of characteristic uniformity rarely exists in the positive grid region. The attention of the designer is again directed to the observations concerning low electrode currents typical of operation in pulse circuitry (paragraph 3.1.9).

3.1.15 LOW SUPPLY VOLTAGE OPERATION. There is no assurance of characteristic uniformity when the plate is operated at a low voltage, as, for example, from 28-volt d-c aircraft supplies. With a very low plate voltage, the cutoff value of bias approaches the value of the "contact potential" effects. Operation in this area must be regarded as extremely unpredictable.

3.1.16 MICROPHONIC BEHAVIOR UNDER SHOCK AND VIBRATION.

3.1.17 Vibration testing and measurement is rarely performed at operating points where characteristic assurance is already available by means of other acceptance tests. The specification limits of vibrational noise wherever such tests are made on triode tubes are shown in figures 3-4 and 3-5. In these figures the microphonic noise limits are referred back to the respective grids of the tubes involved by consideration of the operating level of the tube under test and the characteristics of the average tube of each type.

SECTION 2

APPLICATION OF PENTODES

3.2 PENTODE PROPERTIES.

3.2.1 This section discusses pentode properties and methods of treating them in circuit design. Factors of merit are presented for receiving pentodes in Figure 3-6. The factors and characteristics shown have a direct relationship to pentode applications and are presented for comparison purposes. The test conditions under which the characteristics were determined are those listed in the applicable specifications. Tube properties under actual usage may vary considerably from the values shown. The conditions under which the acceptance tests are performed for various pentodes is given with other information in the section on specific tube types where a treatment of acceptance limits, characteristic variability, and permissible areas of operation appears.

3.2.2 PERMISSIBLE OPERATING CONDITIONS. The permissible operating conditions are considered in relation to the ratings. In general, as the operating condition approaches the ratings, the reliability of the design will be adversely affected, since these define the limiting conditions beyond which there is a complete absence of operating assurance.1/ Figure 3-7, a plate characteristic plot of a typical pentode, shows such a permissible area of operation bounded by heavy lines, representative of the absolute maximum ratings of the type.

3.2.3 MAXIMUM SCREEN DISSIPATION. Boundary 1 indicates the maximum screen dissipation for the tube. It is obtained by consideration of rising screen current at constant screen voltage in the regions of low plate voltage. Screen currents are quite variable, particularly under conditions of fixed bias and low screen current source impedance. Accordingly, this rating should be considered even when the operation of the tube appears to lie well within this boundary.

3.2.4 TEMPERATURE PROBLEM. The general remarks concerning triodes apply to pentodes, namely, that a functional relationship exists between the bulb temperature, plate dissipation and environment, and under certain conditions, the maximum rated bulb temperature may be exceeded unless the plate dissipation is reduced. In many cases, the proper choice of shield, socket 2/ and/or mounting clamp (subminiature) will materially aid in the solution of the temperature problem.

3.2.5 MAXIMUM PLATE VOLTAGE BOUNDARY. The maximum plate voltage boundary (3) is subject to the restrictions mentioned in paragraph 3.2.12.

3.2.6 MINIMUM PLATE CURRENT REGION. Under the usual specification requirements for electron tubes, circuit operation in the minimum plate current

1/ Reference Table 1-3 in Part I.

2/ See WADC Report 53-174, June 1953.

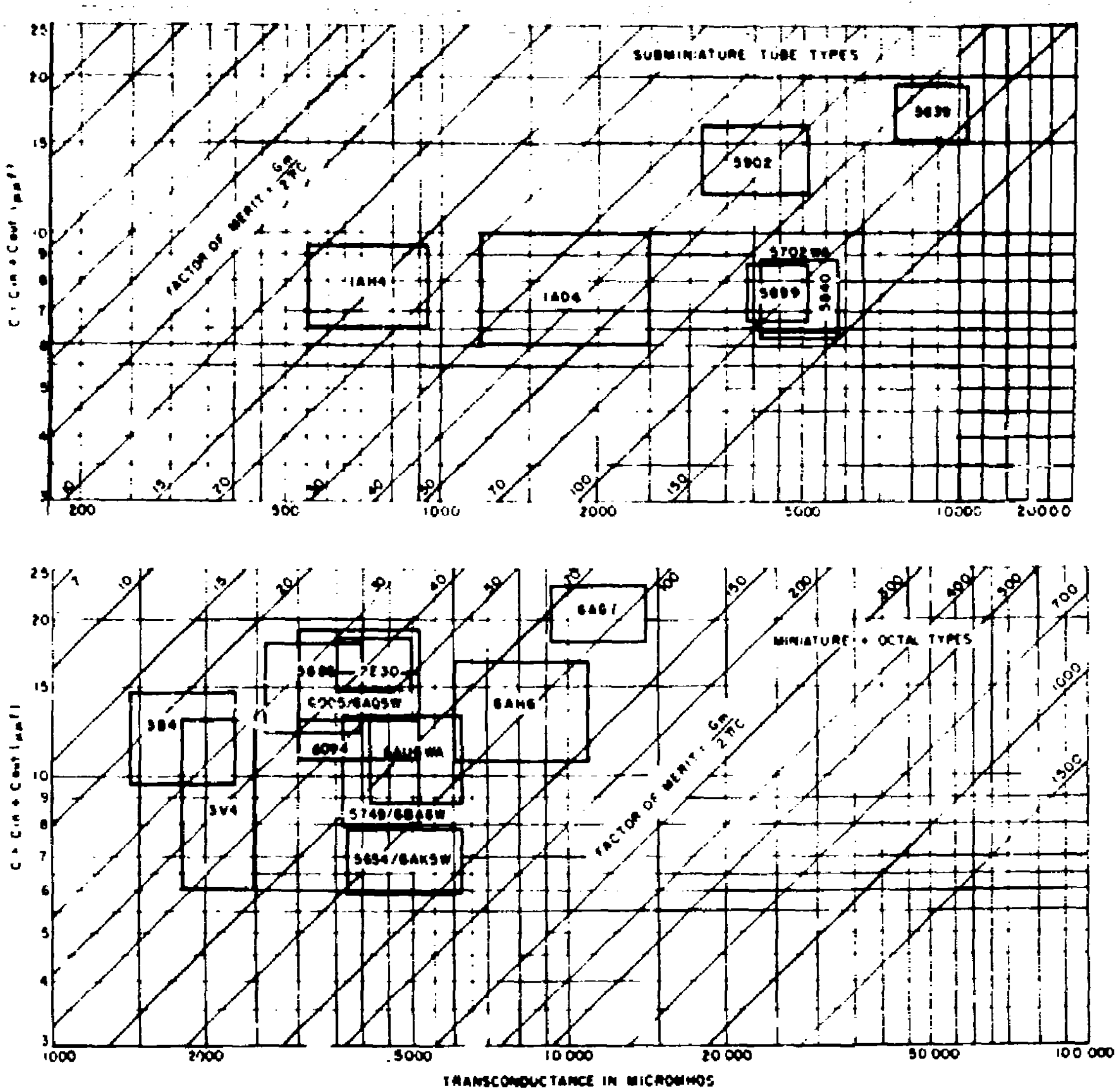

Figure 3-6. Factors of Merit of Receiving Pentodes

region or boundary (4) is not assured when for an appreciable period of time little or no plate current flows with the heater energized. Tube properties are seldom specified in this region and the operational variability may be greater than indicated by the acceptance test limits.

3.2.7 QUESTIONABLE AREAS OF OPERATION. Note should be taken of the two areas (5 and 6) indicated by line shading. Although operation is permissible in these areas, it is questionable for certain applications. Area (5) is that area near or below the plate current knee for the particular value of bias concerned. Tube characteristics in this region are subject to much wider variations than are indicated by the specification limits at the test points. It has been observed that the plate characteristic curves may display unusual shapes in this area giving rise to regions of

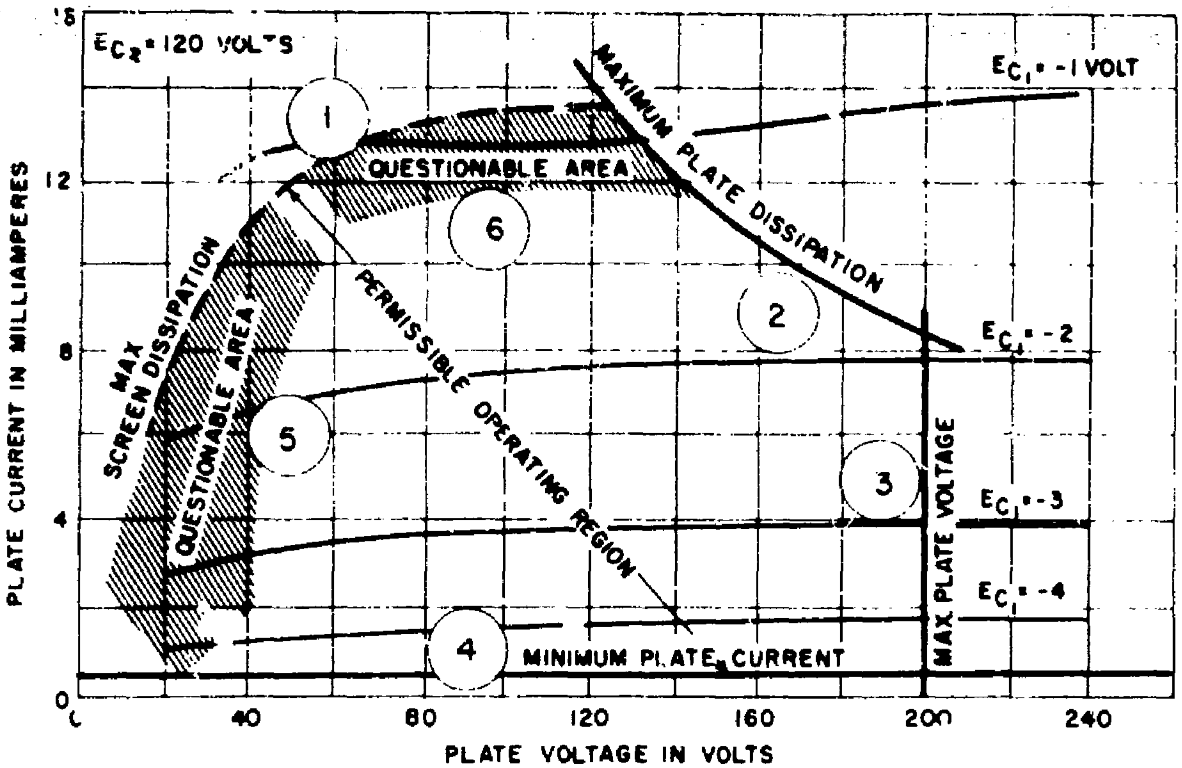

Figure 3-7. Plate Characteristic Plot for a Typical Pentode

low dynamic plate resistance as illustrated in Figure 3-8. The consequent loading of the plate circuit may cause wide variation in stage gain from tube to tube. Also the possibility of inadvertently exceeding the screen dissipation ratings exists in the low plate voltage region of this area.

3.2.8 SCREEN VOLTAGES LARGER THAN PLATE VOLTAGE. Caution should be exercised in application of screen voltages larger than the plate voltage, particularly if low values of control grid bias are likely. Wide variation in characteristics (including possible negative resistance effects) as well as excessive screen dissipation may result.

3.2.9 INITIAL VELOCITY ELECTRON CURRENT. Another questionable area may be considered as containing any value of grid bias at which "initial velocity electron current" may flow in the control grid areas (5 or 6). Tube characteristics in this region are subject to considerable variability primarily due to grid currents resulting from such causes as contact potential and ionic gas currents. The input circuit loading represented by this grid current will vary widely among tubes, and in addition, variations in other characteristics can be expected.

3.2.10 OTHER DESIGN CONSIDERATIONS.

3.2.11 In addition to the limitations of the permissible area of operation discussed

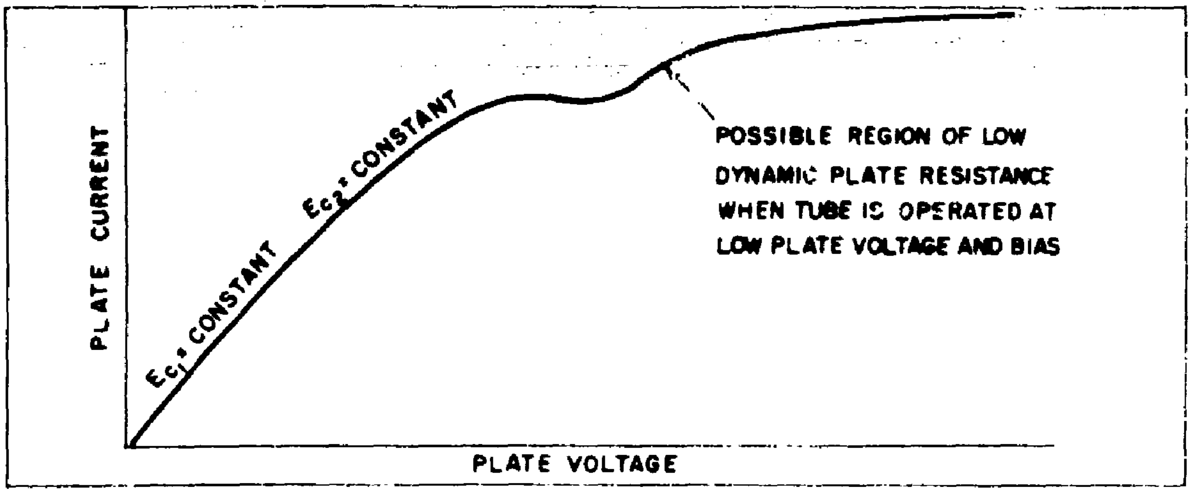

Figure 3-8. **Plate Characteristic Curves in Questionable Areas of Operation**

above, other design considerations not immediately apparent from the specification are treated below for pentode application.

3.2.12 SUPPLY VOLTAGES. A note concerning the use of supply voltages in excess of the rated maximum appears in MIL-E-1 as follows: "Unless otherwise specified on the tube specification sheet, when the load impedance is of such type that the instantaneous voltage at the plate never exceeds the supply voltage, the supply voltage may be twice the maximum rated dc plate voltage, provided the maximum rated average dissipation is never exceeded on any electrode."

3.2.13 LOW ELECTRODE CURRENT. Unless otherwise noted in individual tube-type sections, circuit operation is not assured when the tube, after being held at a low value of plate current for appreciable periods of time, is subjected to higher current demands. Examples of this service are all types of intermittent operation wherein heaters remain energized under conditions of very low or no plate current.

3.2.14 HEATER OPERATION. Attention should be given to heater voltage tolerance ratings. Life and reliability of performance are directly related to the degree that heater voltage is maintained at center rated values. The importance of good heater voltage regulation on the useful life of the tube is evident from Table 1-3 (Part I). Here it is apparent that excessive heater voltage will hasten deterioration within almost every electron tube defect category.

3.2.15 BIAS CONDITIONS. The apparent variability of characteristics of many pentode tube types, as reflected in the specification, is greatly reduced through the use of cathode bias under test conditions. It can be expected, therefore, in applications employing fixed bias, that characteristic variability will exceed that which is evident for such types under MIL-E-1 test conditions.

3.2.16 GRID RETURN RESISTANCE. Caution should also be exercised in the choice

of grid return resistance. Specification assurance on life is lost if the resistance chosen has a value greater than that specified in the intermittent life test conditions.

3.2.17 SCREEN DROPPING RESISTANCE. While MIL-E-1 test conditions normally employ a fixed value of screen supply voltage, the use of a screen dropping resistance in a particular circuit application may result in reduced characteristic variability from that which is evident from consideration of the specification limits. In addition, the use of a screen resistance will reduce the possibility of inadvertently exceeding the screen dissipation rating.

3.2.18 A-C OPERATION OF PLATE AND SCREEN. Considerable caution should be exercised in supplying plate or screen potentials from alternating voltage sources. In such applications, the negative excursions afford an opportunity for electron emission to the control grid, resulting in a negative shift of bias. In addition, the positive alternating voltage peaks may draw cathode current sufficient to impair the operation of the tube.

3.2.19 PULSE OPERATION. In general, the testing of all electron tubes is performed at discreet test points and unless specific tests provide assurance of pulse operation, assumptions may not be made regarding such operation. Specification assurance of characteristic uniformity rarely exists in the positive grid region. The attention of the designer is again directed to the observations concerning low electrode currents typical of operation in pulse circuitry discussed in paragraph 3.2.13.

3.2.20 TRIODE CONNECTION. Specification assurance of uniformity in characteristics is lost when pentode tubes are operated as triodes.

3.2.21 LOW SUPPLY VOLTAGE OPERATION. There is no assurance of characteristic uniformity when the tube is operated from very low plate and screen supplies such as 28 volts dc. In addition, low values of screen voltage reduce the control grid bias required for cutoff of plate current. With very low values of screen voltage, the cutoff value of bias may approach the "contact potential" of the tube causing operation in the questionable area of "initial velocity electron current."

3.2.22 SCREEN GRID CIRCUIT PROTECTION. Designers should insure that plate and screen supply voltages are supplied from a common chassis plug or preferably a common terminal within each individual chassis to prevent the accidental removal of plate voltage without concurrent removal of screen grid voltage. Removing the plate supply voltage with the screen grid voltage remaining on can result in excessive screen grid current and screen dissipation, resulting in severe deterioration of electrical characteristics, or even destruction of the screen.

3.2.23 MICROPHONIC BEHAVIOR UNDER SHOCK VIBRATION.

3.2.24 Vibration testing and measurement is rarely performed at operating points where characteristic assurance is already available by means of other acceptance tests. The specification limits of vibrational noise wherever such tests are made on pentodes and dual control tubes are shown in figures 3-9 and 3-10. In these figures the micriphonic noise limits are referred back to the respective grids of the tubes involved by consideration of the operating level of the tube under test and the characteristics of the average tube of each type.

3.2.25 Similar comparisons have been made between filamentary types and also between power output types both triodes and pentodes. These comparisons are made in figure 3-11 and 3-12.

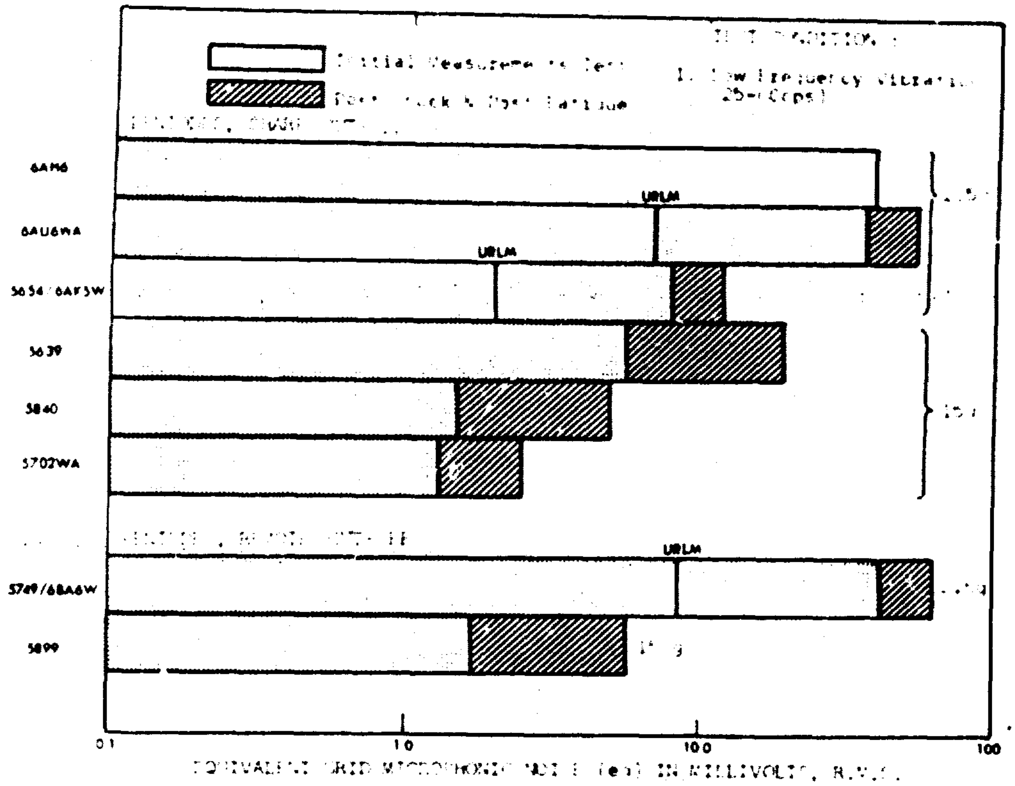

Figure 3-9. Equivalent Grid Microphonic Noise Limits for Receiving Pentodes

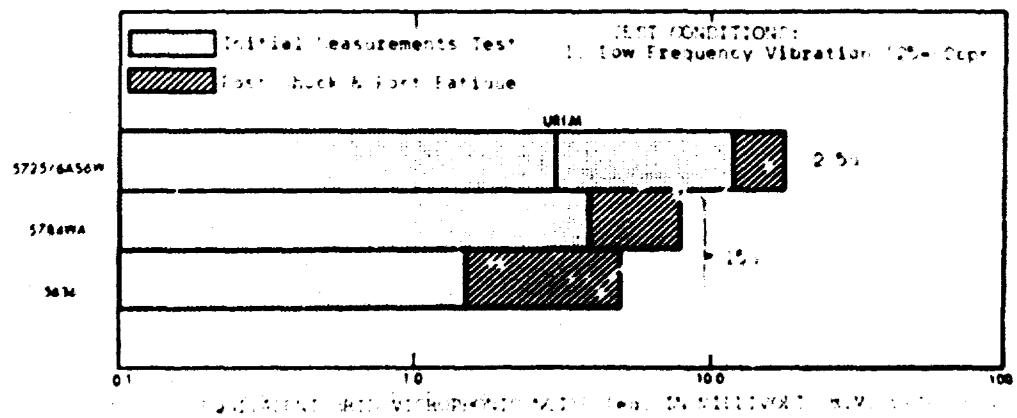

Figure 3-10. Equivalent Grid Microphonic Noise Limits for Dual Control Tubes

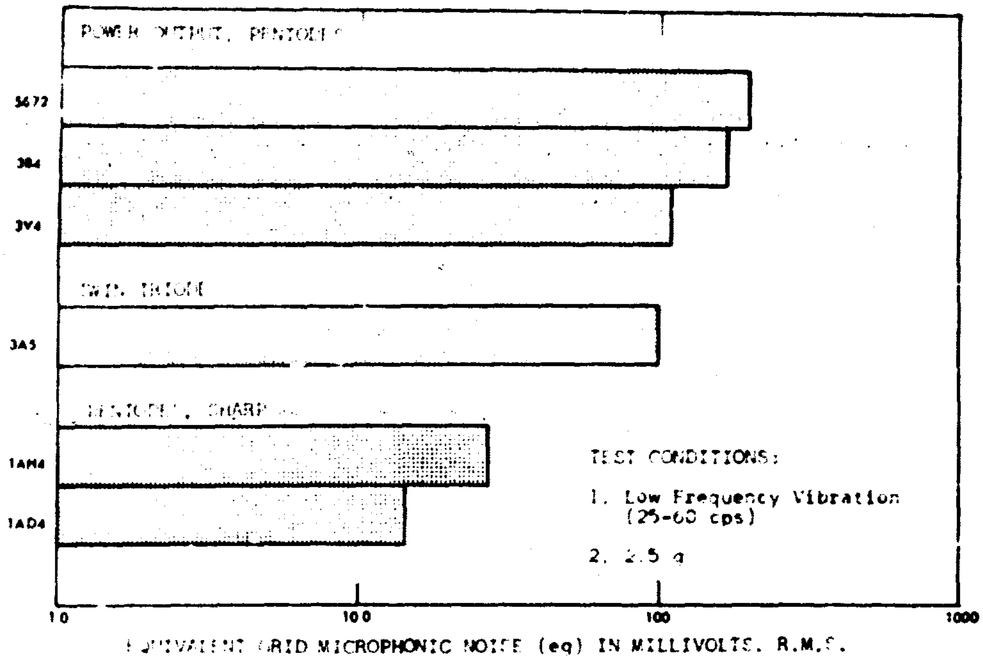

Figure 3-11. Equivalent Grid Microphonic Noise Limits for Filamentary Receiving Tubes

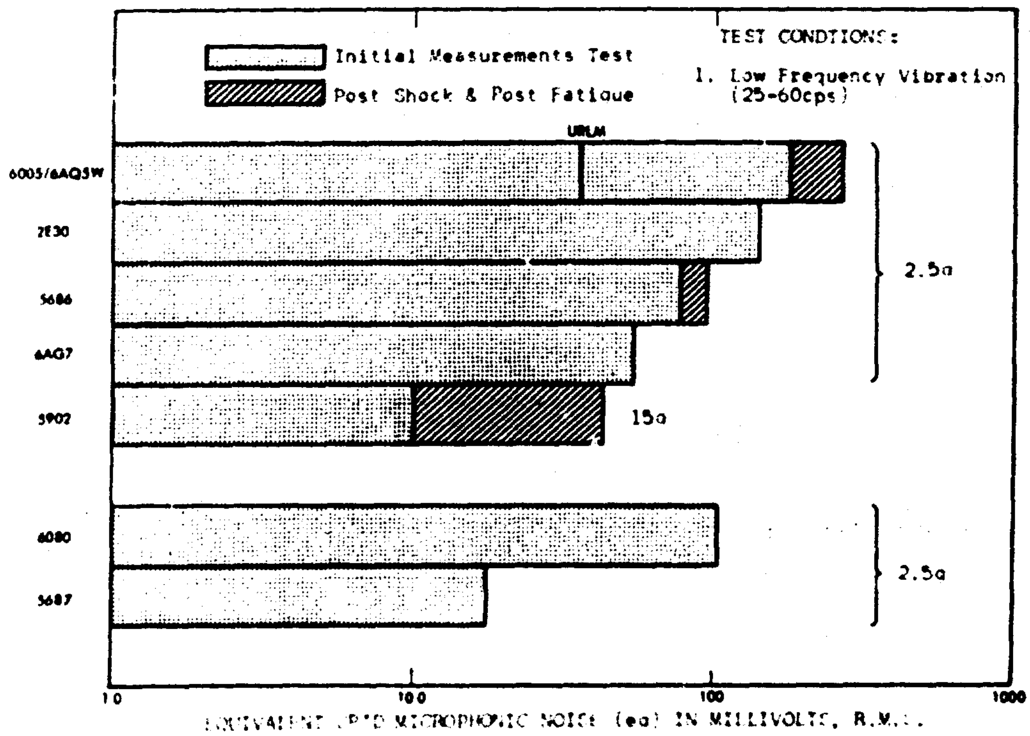

Figure 3-12. Equivalent Grid Microphonic Noise Limits for Power Output Triodes and Pentodes

3.3 RECTIFIER PROPERTIES.

3.3.1 This section discusses rectifier properties and methods of treating them in circuit design. In figures 3-13 and 3-14 rectifier tube types taken from MIL-STD-200C electron tube list are graphically compared in relation to their output current and inverse peak voltage ratings. The charts are presented for comparison purposes only since it is not wholly descriptive of the limiting conditions of operation. The conditions under which the acceptance tests are performed for various rectifiers are given with other information in the section on specific tube types where a treatment of acceptance limits, characteristic behavior, and permissible areas of operation appears.

3.3.2 PERMISSIBLE OPERATING CONDITIONS. The permissible operating conditions are considered in relation to the ratings. In general, as the operating condition approaches the ratings, the reliability of the design will be adversely affected, since these define the limiting conditions beyond which there is a complete absence of operating assurance.[1/]

3.3.3 RATING CHARTS. Inasmuch as the observance of correct rectifier operation depends on the choice of several circuit parameters external to the tube, more than one permissible operating area may be required to define properly the region within the ratings. Commonly, three or more "rating charts" are employed for such purposes. It must be emphasized that the use of a rectifier within its ratings implies that it is operating within the permissible areas of each of its rating charts. Consideration of all ratings and rating charts is therefore important in the choice of an operating point. It should be borne in mind that all ratings are based on the "absolute maximum system" and are not to be exceeded under any service condition (see paragraph 1.1.3). The rating charts which follow exemplify the corresponding charts for the specific rectifier tube types discussed later. Rating Charts I, II, and III are derived from the specification ratings by methods given in the "Manual of Practice" for the Joint Electron Tube Engineering Council. Rating Charts I and II must be used in combination, in connection with the design of capacitive input filter applications. Hence, they are presented side by side to permit easy projection of points from one to the other.

3.3.4 RATING CHART I. A typical Rating Chart I is shown in Figure 3-15. Here the permissible operating area for both choke and capacitor input circuits is defined by the maximum rated d-c output current (per plate) and the RMS plate voltage. Point E corresponds to the intermittent life test condition given in the applicable MIL-E-1 specification. Point C corresponds to the conditions of maximum

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[1/] Reference Table 1-3 in Part I.

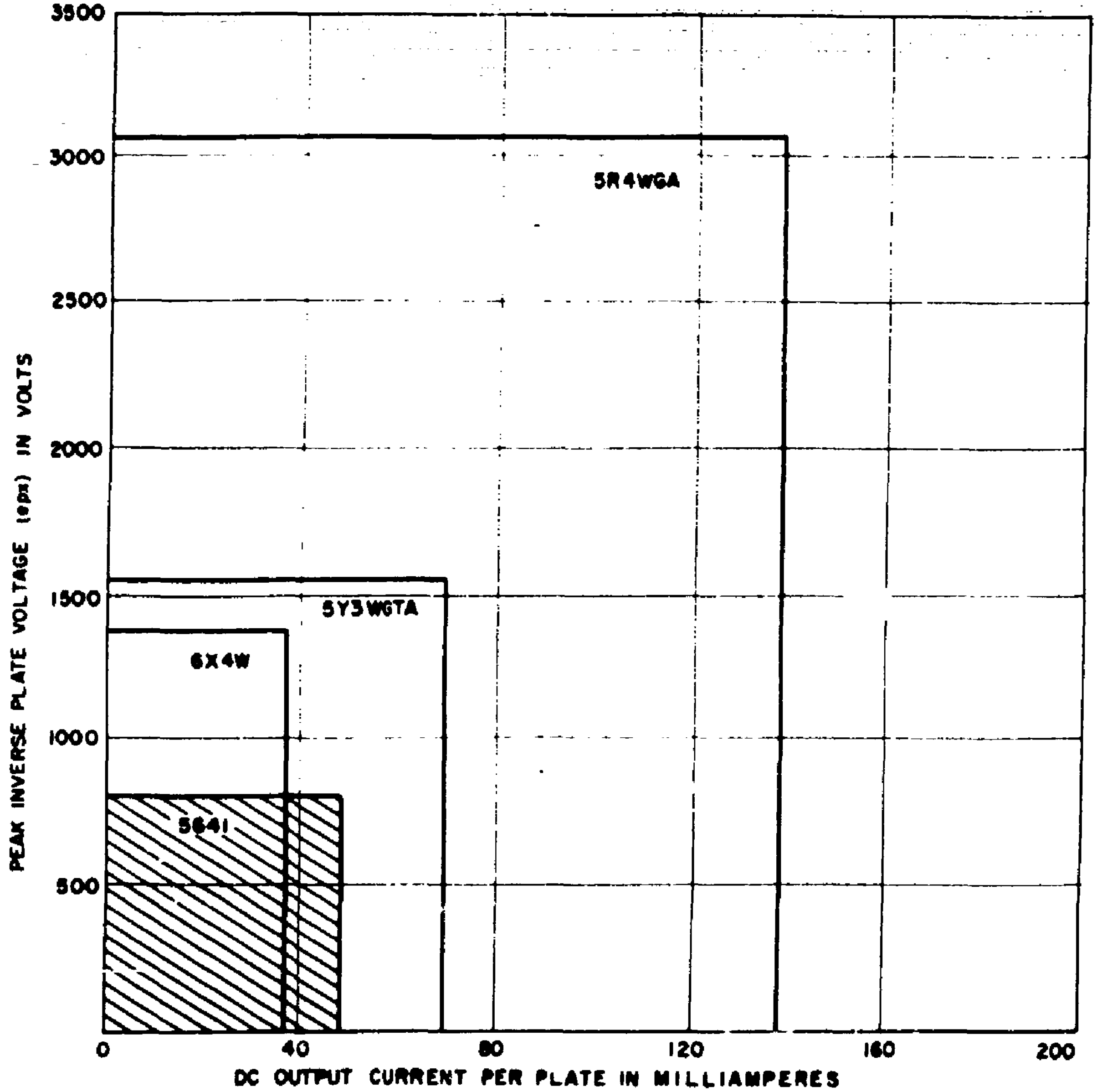

Figure 3-13. Comparison of Output Currents and Inverse Peak Voltage Ratings for Rectifier Tube Types

inverse peak voltage and maximum dc output current, as given by the rating.

3.3.5 RATING CHART II. An example of Rating Chart II is shown in Figure 3-16. This chart is applicable only to capacitor input filter operation and defines the permissible operating area by the maximum rated d-c output current per plate and the rectification efficiency corresponding to maximum rated steady-state peak plate current as given in the applicable specification. Rectification Efficiency is defined as:

$$\frac{\text{DC Output Voltage } (E_o)}{\text{Peak Plate Voltage } (\sqrt{2}E_{pp}/p)}$$

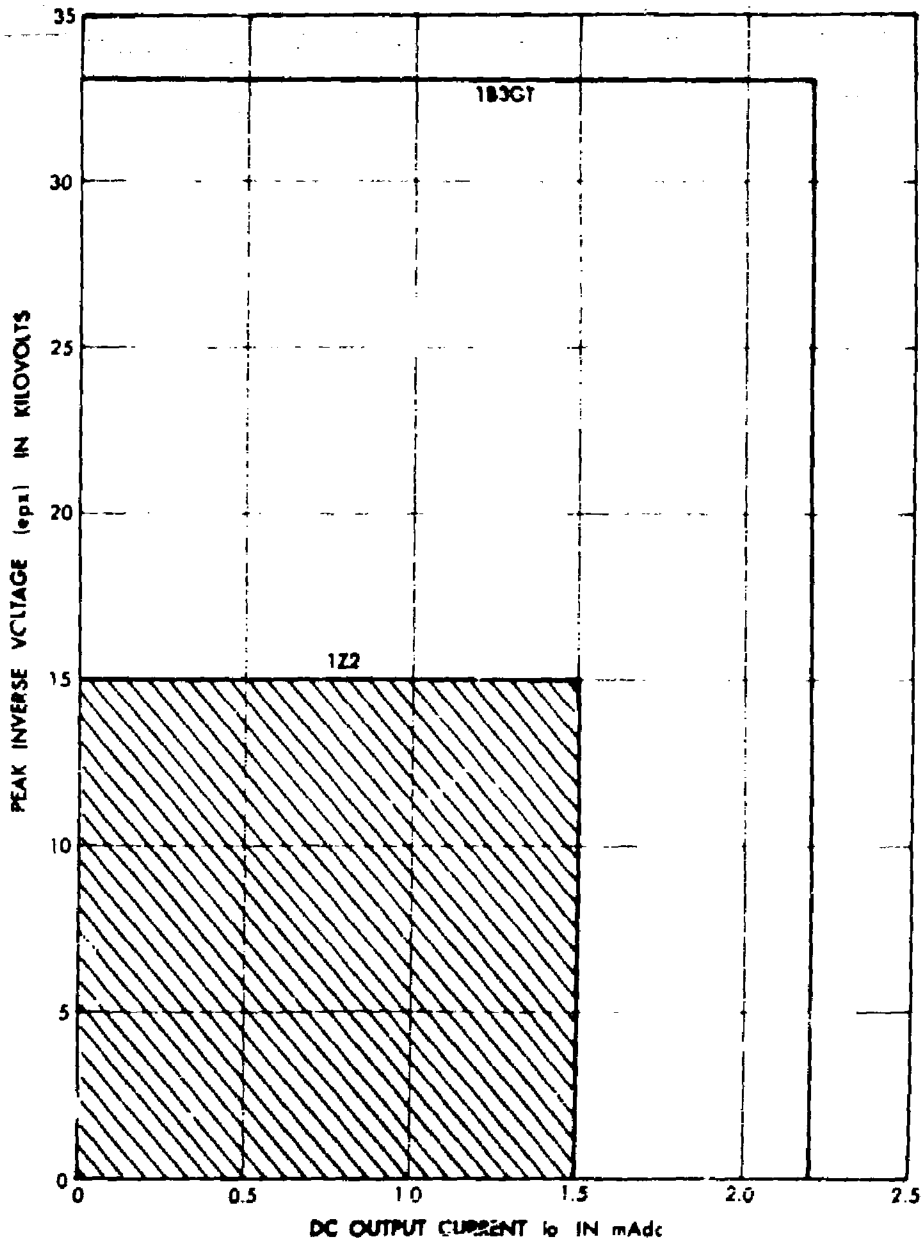

Figure 3-14. Comparison of Output Current and Inverse Peak Voltage Ratings for High Voltage Rectifier Tube Types

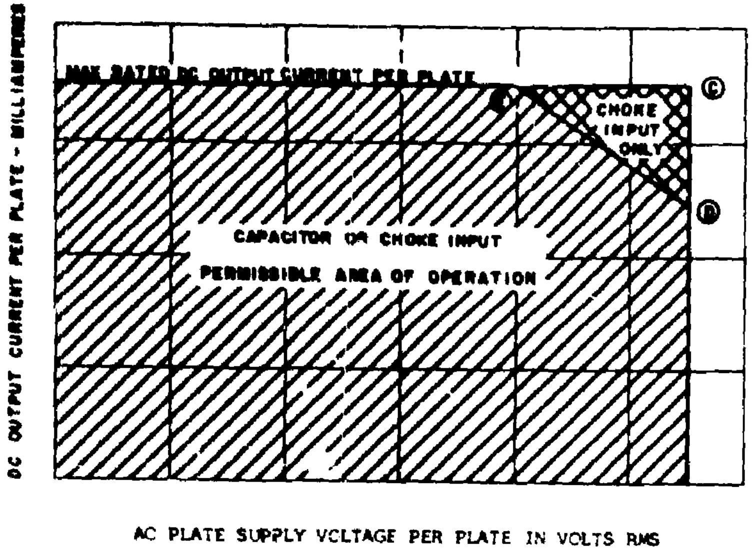

Figure 3-15. Typical Rating Chart I for Rectifier Tube Types

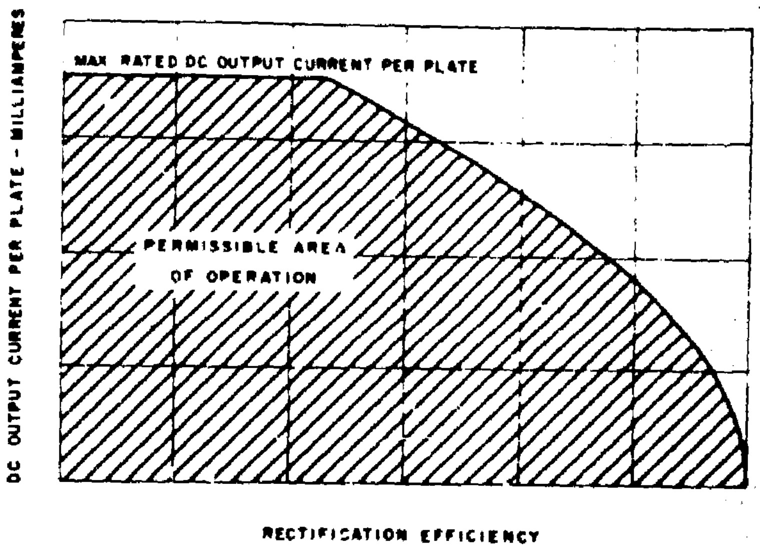

Figure 3-16. Typical Rating Chart II for Rectifier Tube Types

3.3.6 RATING CHART III. Figure 3-17 shows the permissible operating area as defined by Rating Chart III. This chart gives the minimum allowable resistance effectively in series with each plate of the rectifier tube for any allowable a-c plate voltage. The boundary conditions are derived from the maximum instantaneous surge current rating for the tube. The effective series plate supply resistance per plate, Rs, may be calculated from circuit measurements:

$$Rs = Rsec + N^2 Rpri + Ra$$

Where: Rsec = d-c resistance of transformer secondary/section
Rpri = d-c resistance of transformer primary
Ra = d-c resistance added in series per plate
N = transformer voltage step-up ratio per section
With series inductance, series resistance may be less than shown provided i Surge rating is not exceeded.

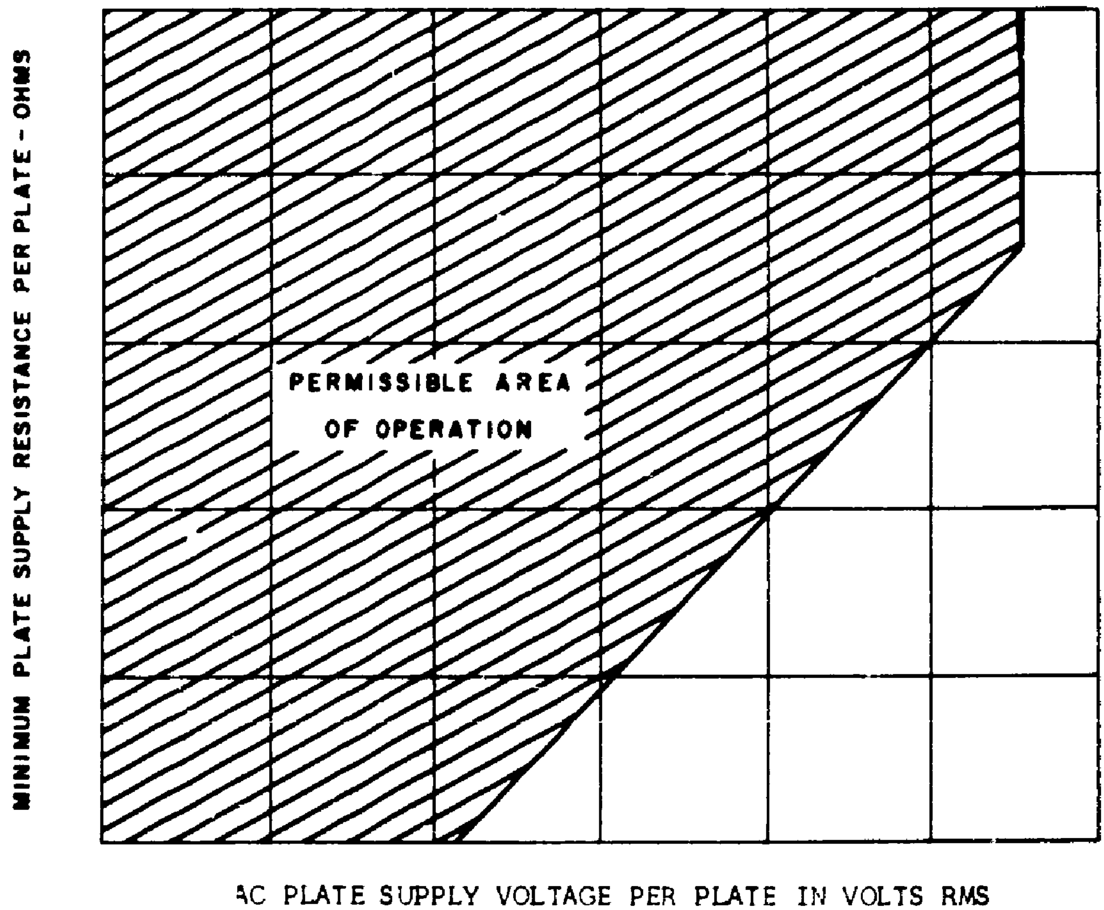

Figure 3-17. Typical Rating Chart III for Rectifier Tube Types with Capacitor Input Filter Operation

3.3.7 HIGH ALTITUDE OPERATION. Caution should be exercised in the design of rectifier circuits which will operate in unpressurized enclosures at high altitudes. Freedom from arc-over is not assured by the specification if operation at pressures lower than that equivalent to the maximum rated altitude is attempted. In addition, convection cooling of the rectifier envelope may be reduced at low atmospheric pressures and endanger the operation due to excessive envelope temperature. High altitude derating is specified for some rectifier types by suitable rating charts set forth in the individual specification.

3.3.8 TIME DELAY RATING. The simultaneous application of plate and heater voltage may result in excessive cathode bombardment and materially shorten the useful life of the tube. When this factor is to be considered in circuit application, time delays appear as ratings in the applicable specification. In some cases, this rating is also presented by a rating chart, defining more completely the conditions of input voltage and output current for which the application of plate voltage should be delayed.

3.3.9 HEATER OPERATION. Attention should be given to heater voltage tolerance ratings. Life and reliability of performance are directly related to the degree that the heater voltage is maintained at center rated values. The importance of good heater voltage regulation on the useful life of the tube is evident from Table 1-3 (Part I). Here it is indicated that excessive heater voltage will hasten deterioration within almost every electron tube defect category.

SECTION 4

APPLICATION OF DIODES

3.4 DIODE PROPERTIES.

3.4.1 This section discusses diode properties and methods of treating them in circuit design. Diode types included in MIL-STD-200C are compared graphically in Figure 3-18 in relation to their respective output current and inverse peak voltage ratings. The chart is presented for comparison purposes only and is not wholly descriptive of the limiting conditions of operation. The conditions under which the acceptance tests are performed for various diodes is given with other information in the sections on specific types where a treatment of acceptance limits, characteristic variability, and permissible areas of operation appears.

3.4.2 PERMISSIBLE OPERATING CONDITIONS. The permissible operating conditions are considered in relation to the ratings. In general as the operating condition approaches the ratings, the reliability of the design will be adversely affected, since these ratings define limiting conditions beyond which there is a complete absence of operating assurance.[1/] Figure 3-19. an average plate characteristic plot of a typical diode, shows the permissible limits of operation bounded by heavy lines representative of the absolute maximum ratings of the type. Limit (1) is the maximum peak-plate current (ib) rating. Limit (2) is the maximum d-c output current per plate rating.

3.4.3 Normal application of diodes in signal rectifier service -- modulators, demodulators, limiters, clippers, clampers, etc., requires attention to the shaded region indicated as Area 3 on the chart. Area 3, though well within the limits of permissible operation, is a questionable area for small signal applications. Initial uniformity of electrical characteristics in this area and stability of these characteristics through life is adversely affected by heater voltage variation. Although individual specifications may enforce control of plate current balance between sections of dual diodes in this region under conditions of design center heater voltage, no assurance of balance through life may be afforded.

3.4.4 RATING CHARTS. Although the diodes discussed herein are used primarily in signal rectification applications, at low signal levels, there are other applications in large signal and supply voltage rectifier service wherein rectifier Rating Charts I, II and III become applicable. On the basis of their absolute maximum ratings, such charts have been developed for individual types within the signal diode category. Refer to paragraphs 3.3.3 through 3.3.6 for a general discussion of these charts.

3.4.5 OTHER DESIGN CONSIDERATIONS

3.4.6 Design considerations other than the limitations discussed above, which are

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1/ Reference Table 1-3 in Part I.

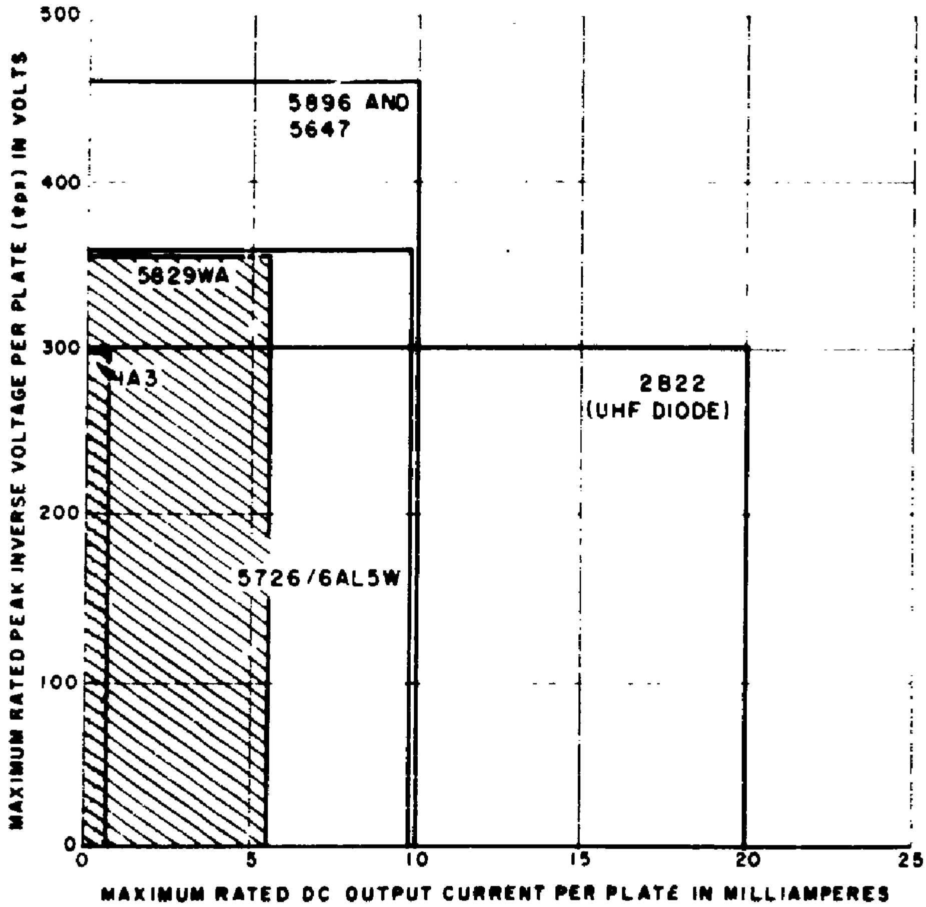


Figure 3-18. Comparison of the Receiving Diodes

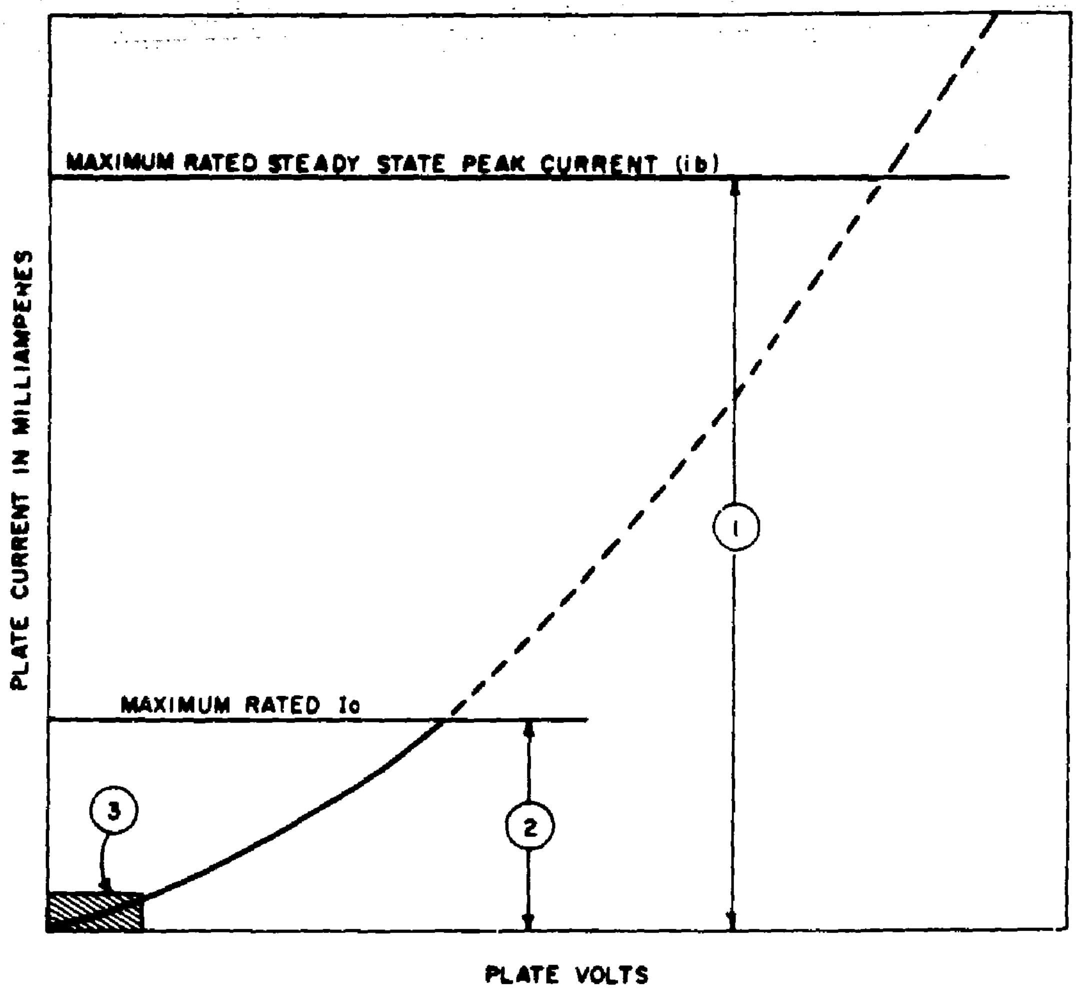


Figure 3-19. Limits of Operation for Diodes

not immediately apparent from the specification include the following:

3.4.7 LOW ELECTRODE CURRENT. Unless otherwise noted in individual tube type sections, circuit operation is not assured when the tube, after being held at a low value of plate current for appreciable periods of time, is subjected to higher current demands. Examples of this service are all types of intermittent operation wherein heaters remain energized under conditions of very low or no plate current.

3.4.8 HEATER OPERATION. Attention should be given to heater voltage tolerance ratings. Life and reliability of performance are directly related to the degree to which the heater voltage is maintained at center rated value. Specifications for

some types enforce a control of heater current toward a design center value through maximum limits on the allowable shift of lot averages and a limit on the spread or dispersion.

SECTION 5

TUBE TYPE JAN-1A3

3.5 DESCRIPTION.

3.5.1 The JAN-1A3 1/ is a seven pin, button base miniature, heater-cathode type U.H.F. diode.

3.5.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 1.4 Vdc
Cathode . . . . Coated Unipotential

3.5.3 MOUNTING. Not specified.

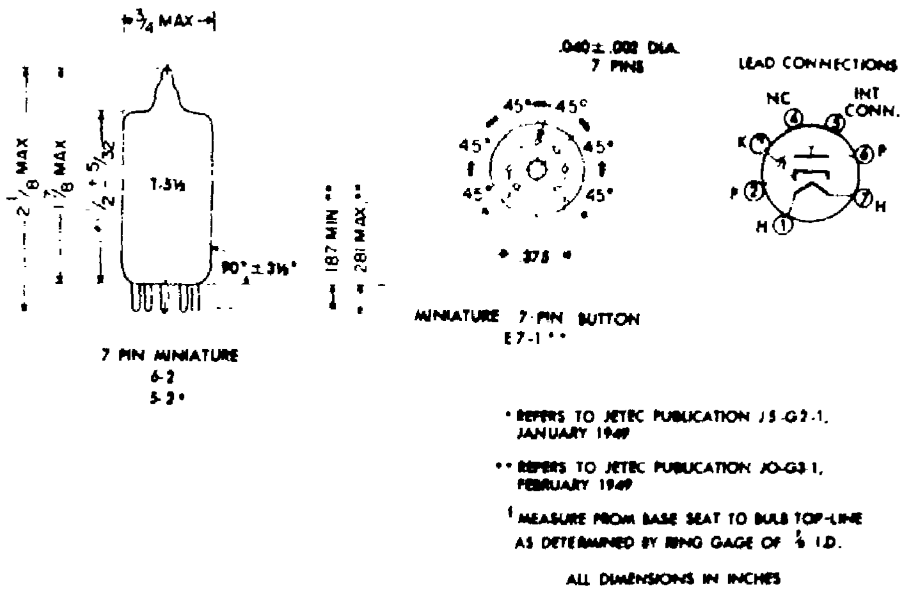


Figure 3-20. Outline Drawing and Base Diagram of Tube Type JAN-1A3

3.5.4 RATINGS, ABSOLUTE SYSTEM.

3.5.5 The absolute system ratings are as follows:

Heater Voltage . . . . 1.4 Vdc ± 15%
Peak Inverse Plate Voltage . . . . 365 v
Steady State Peak Plate Current . . . . 5.5 ma
DC output current . . . . 0.55 mAdc
Heater Cathode Voltage . . . . 100 V
* Altitude Rating . . . . 10,000 ft

---

* No test for this rating exists in the specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/19 dated 5 February 1953.

3.5.6 TEST CONDITIONS AND CHARACTERISTICS.

3.5.7 Test conditions and characteristics are as follows:

Heater Voltage, Ef .... 1.4 Vdc
Secondary Voltage to Plate, Epp .... 50 Vac
Series Resistance, Rp .... 0.1 Meg
Load Capacitor, CL .... 2 uf

3.5.8 ACCEPTANCE TEST LIMITS.

3.5.9 The following table summarizes certain salient requirements set forth by the the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/19 dated 5 February 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-4. ACCEPTANCE TEST LIMITS OF JAN-1A3

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		138	162	---	---	mAdc
Operation	Io	Ef = 1.1 V	0.36	---	0.30	---	mAdc
Emission	Is	Eb = 10 Vdc Ef = 1.1 V	0.8	---	---	---	mAdc
Heater-Cathode Leakage	Ihk	Ehk = Eo	0	20	---	---	uAdc
Resonant Frequency		F = 500 mc	(SEE SPECIFICATION FOR LIMITS)				
Capacitance (unshielded)	Cpkl	Ef = 0	0.2	0.6	---	---	uuf
	Cph	Ef = 0	0.6	1.0	---	---	uuf
	Chk	Ef = 0	0.4	0.8	---	---	uuf

3.5.10 APPLICATION.

3.5.11 SIGNAL RECTIFIER SERVICE: In the application of JAN-1A3 in signal rectifier and discriminator service, Fig. 3-21 relates boundaries of permissible operation and the questionable area of operation, to the plate characteristic.

3.5.12 Permissible steady state peak plate current is limited to 5.5 milliamperes, to define boundary (1), and dc output current is limited to 0.55 milliamperes, to define boundary (2). Area (3) is defined as questionable from the standpoint of uniformity and stability of plate current in low-level signal applications. Reference should be made to Section 1.3.4 for a review of the effects of initial electron velocity and contact potential in tubes in general, where the control grid currents discussed are equivalent to plate currents in signal diode application.

3.5.13 SUPPLY VOLTAGE RECTIFIER SERVICE: Rating Charts for supply voltage rectifier service are not provided for the JAN-1A3.

3.5.14 OTHER CONSIDERATIONS.

3.5.15 HEATER VOLTAGE: See paragraph 3.4.8.

3.5.16 LOW ELECTRODE CURRENT: See paragraph 3.4.7.

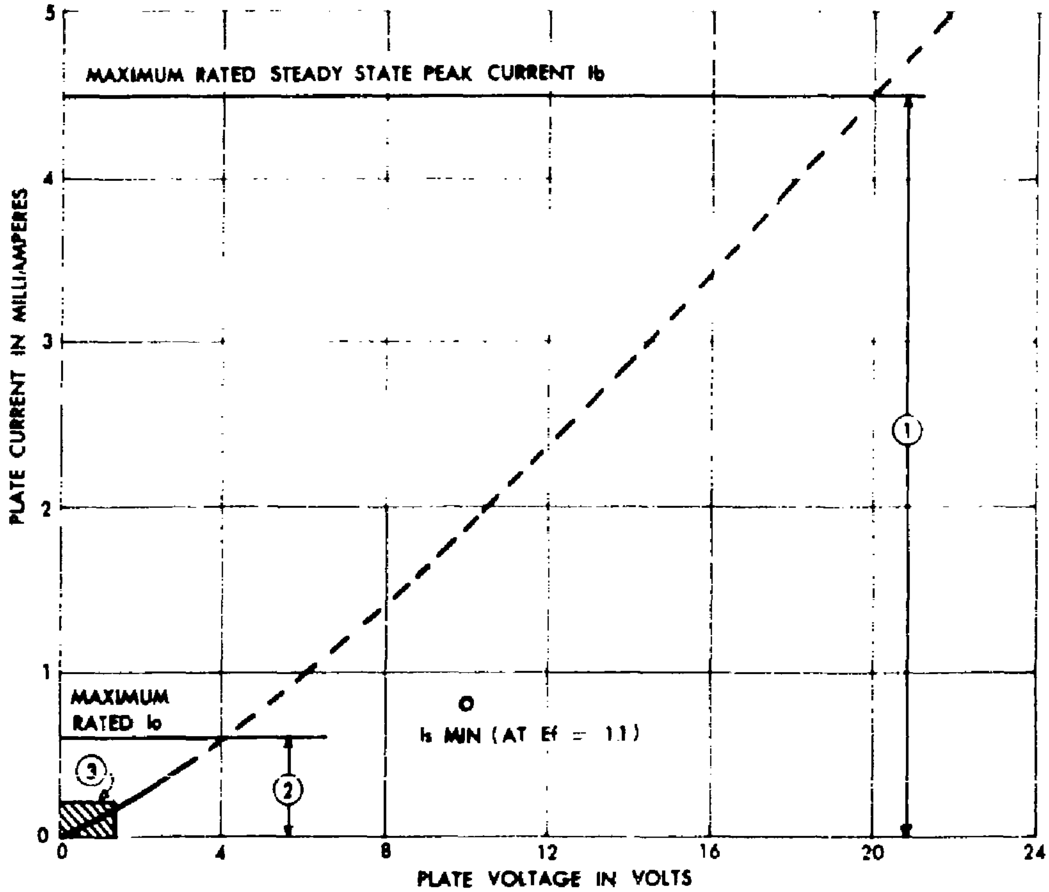


Figure 3-21. Permissible Limits of Operation for Tube Type JAN-1A3

3.5.17 TYPICAL CHARACTERISTICS.

3.5.18. The chart below presents the Static Plate Characteristic of JAN-1A3, reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification which provides only a minimum limit on emission.

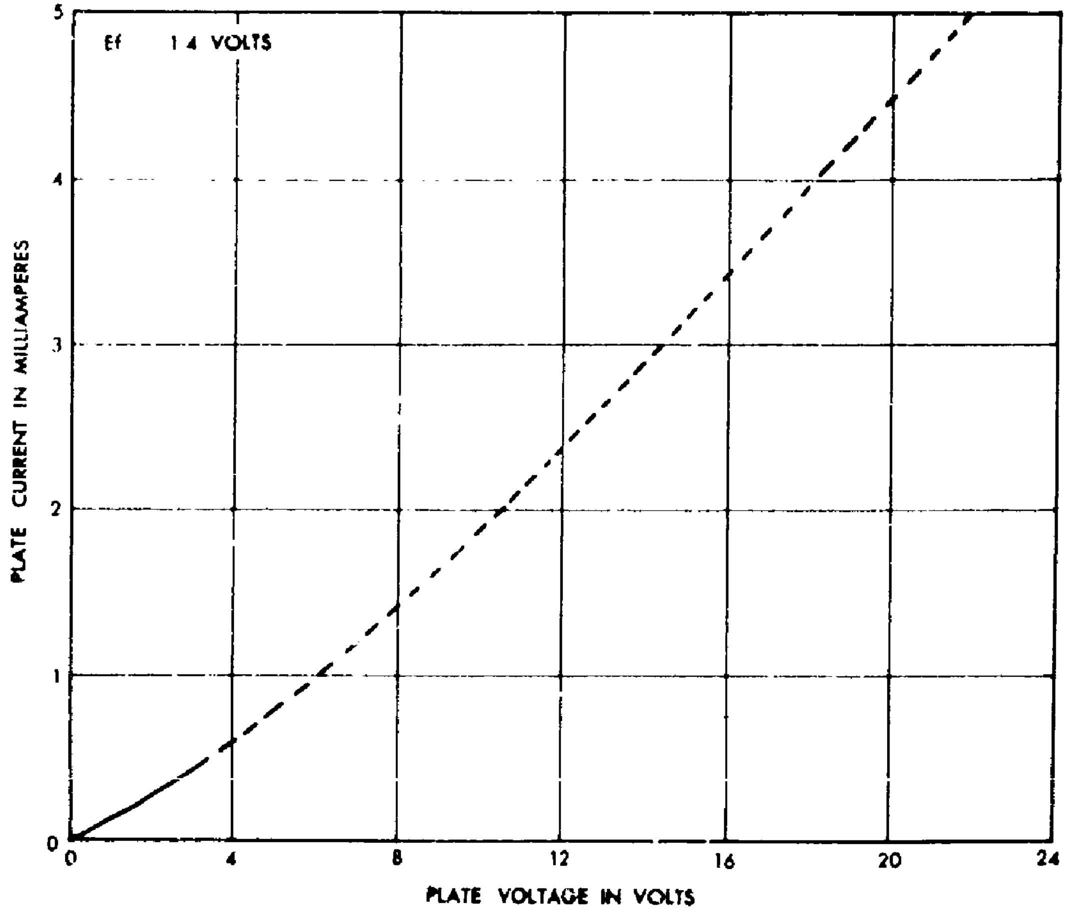


Figure 3-22. Typical Plate Characteristic for Tube Type JAN-1A3

TUBE TYPE JAN-1AD4

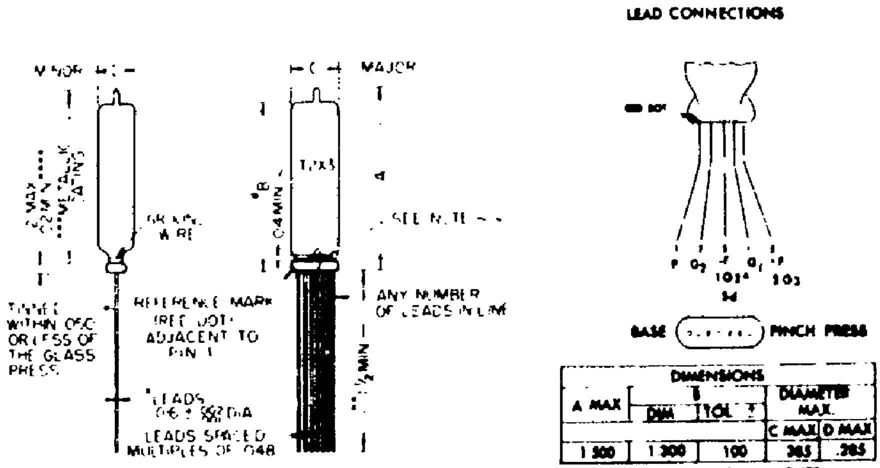
3.6 DESCRIPTION.

3.6.1 The JAN-1AD4 1/ is a 5 lead, pinch press, subminiature RF sharp cut-off filamentary receiving pentode with a metallic shield coating.

3.6.2 ELECTRICAL. The electrical characteristics are as follows:

Filament Voltage	1.25 Vdc
Filament Current	88 - 112 mAdc
Cathode	Coated Filament

3.6.3 MOUNTING. Not specified.



DIMENSIONS				
A MAX	B DIM	B TOL ±	DIAMETER MAX. C MAX	DIAMETER MAX. D MAX
1 500	1 300	100	385	.285

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF 210 ± 001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE 003 INCREASE OVER THE ACTUAL LEAD DIAMETER

*** WHEN SPECIFIED ON THE TSS

**** APPLIES TO PINCH PRESS TYPES ONLY (02 MIN)

† GROUND LEAD OVERLAPPED BY SHIELD BY A MINIMUM OF .04

‡ SHIELD TO GROUND WIRE MAY BE FROM EITHER SIDE OF THE MAJOR DIMENSION ALTERNATIVE CONSTRUCTION: UNUSED OR EXTRA RANDOM LEAD IN PRESS OR BUTTON MAY BE FOLDED BACK AND WRAPPED AROUND BULB TO MAKE CONTACT WITH SHIELD

^ GRID 3 IS COMPOSED OF 2 SEPARATE DEFLECTOR PLATES, ONE OF WHICH IS CONNECTED TO PIN 3 AND THE OTHER TO PIN 5

Figure 3-23. Outline Drawing and Base Diagram of Tube Type JAN-1AD4

1/ The values and specification comments presented in this section are related to MIL-E-1/20A dated 9 July 1953.

3.6.4 RATINGS, ABSOLUTE SYSTEM.

3.6.5 The absolute system ratings are as follows:

Filament Voltage	1.25 ± 0.25 Vdc
* Plate Voltage	100 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
* Screen Grid Voltage, Maximum	100 Vdc
* Cathode Current, Maximum	7.0 mAdc
* Altitude Rating	10,000 ft

3.6.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.6.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	1.25 Vdc
Control Grid Voltage, Ec1	0 Vdc
Plate Voltage, Eb	45 Vdc
Screen Voltage, Ec2	45 Vdc
Control Grid Series Resistance	2 Meg

3.6.8 ACCEPTANCE TEST LIMITS.

3.6.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise in-

TABLE 3-5. ACCEPTANCE TEST LIMITS OF JAN-1AD4

PROPERTY		MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIMITS LIFE TEST MIN	LIMITS LIFE TEST MAX	UNITS
Heater Current	If		88	112	---	---	mA
Transconductance (1)	Sm	Ef = 1.0 Vdc	1200	2500	---	---	umhos
Transconductance (2)	Sm		1500	2500	1200	---	umhos
Plate Current (1)	Ib		1.9	4.1	---	---	mAdc
Screen Grid Current	Ic2		0.5	1.3	---	---	mAdc
Plate resistance	Rp		0.2	---	---	---	Meg
Capacitance	Cgp		---	0.01	---	---	uuf
	Cin		3.0	5.0	---	---	uuf
	Cout		3.0	5.0	---	---	uuf
Grid Current	Ic	Ec1 = -0.5 Vdc Rg1 = 0.1 Meg	---	-0.5	---	---	uAdc

* No test at this rating exists in the specification.

tended to include all the properties for which measurement limits are provided. Specification MIL-E-1/20A dated 9 July 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.6.10 APPLICATION.

3.6.11 The chart below shows the permissible operating area for JAN-1AD4 as defined by the ratings in MIL-E-1/20A dated 9 July, 1953. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2 through 3.2.8.

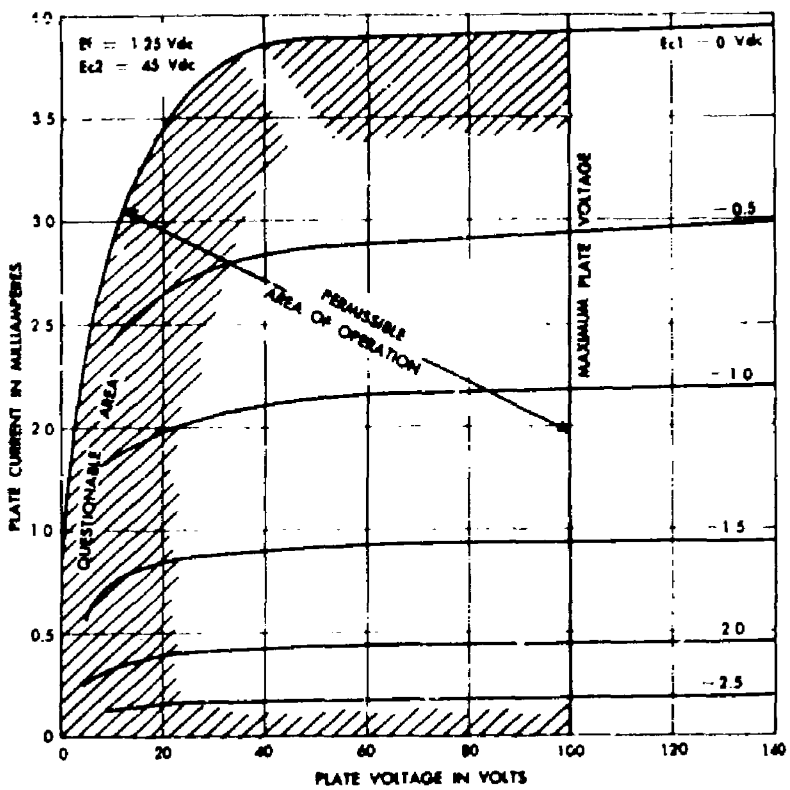


Figure 3-24. Typical Static Characteristics of Tube Type JAN-1AD4; Permissible Area of Operation.

3.6.12 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-6. APPLICATION PRECAUTIONS FOR JAN-1AD4

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15
- Fixed, 1.3.8, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Temperature

Bulb and Environmental, 3.2.4

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Miscellaneous

Plus Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.6.13 VARIABILITY OF CHARACTERISTICS.

3.6.14 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the specified acceptance limits.

3.6.15 The charts below present the limit behavior of static plate characteristics for JAN-1AD4 as defined by MIL-E-1/20A dated 9 July 1953.

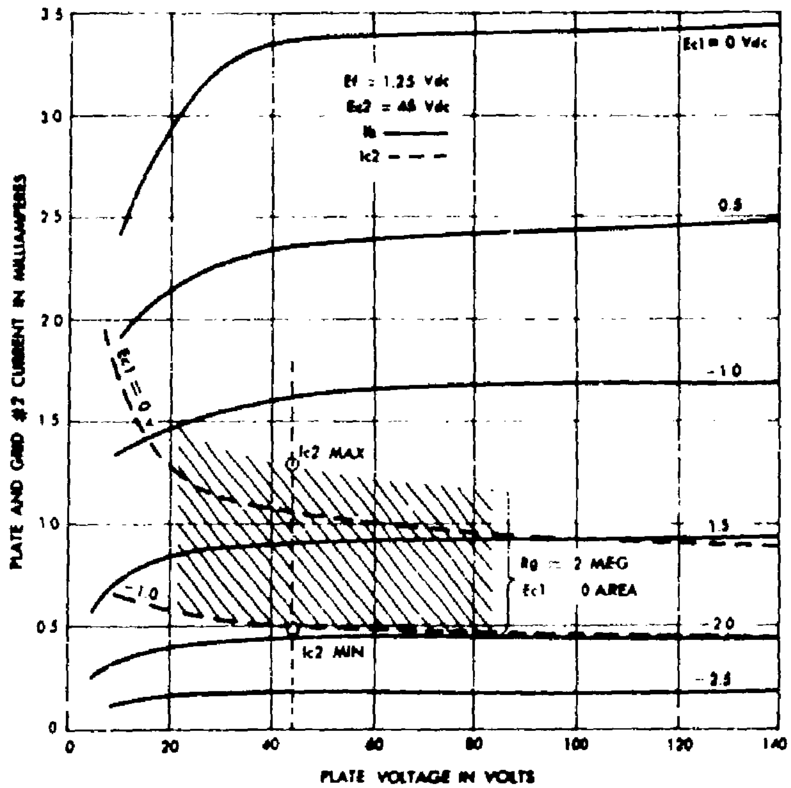


Figure 3-25. Limit Plate Characteristics of Tube Type JAN-1AD4; Variability of Ic 2

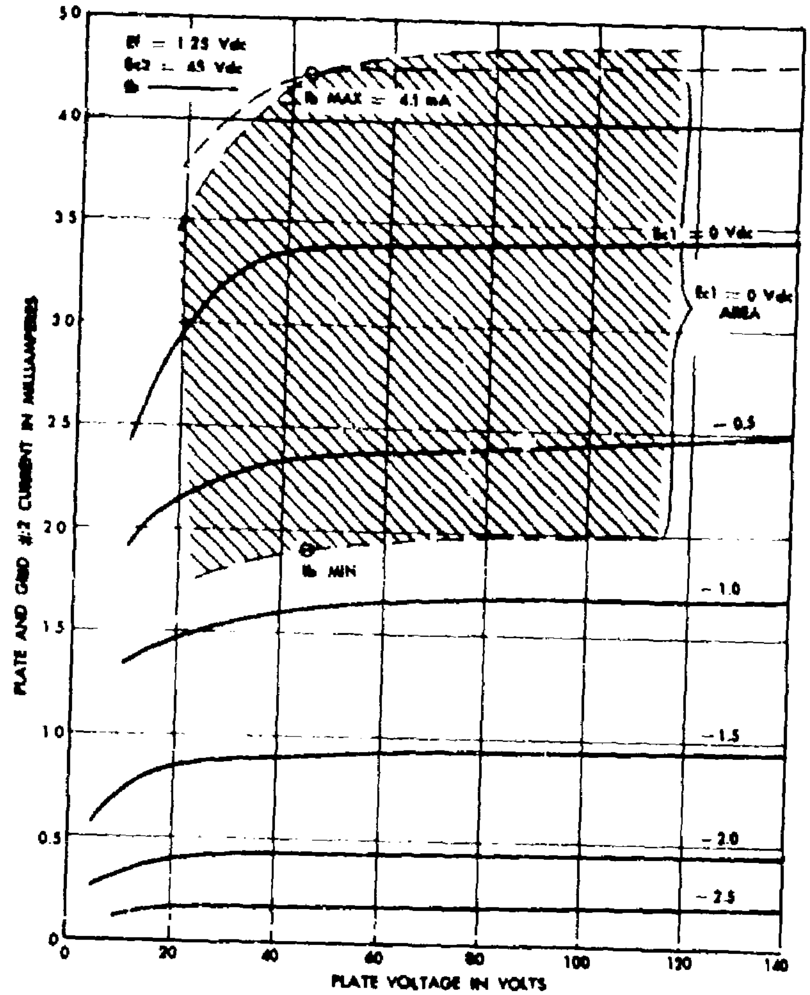


Figure 3-26. Limit Plate Characteristics of Tube Type JAN-1AD4; Variability, of $\bar{I}b$

3.6.16. The chart below presents the limit behavior of transfer data for JAN-1AD4 as defined by MIL-E-1/20A dated 9 July 1953.

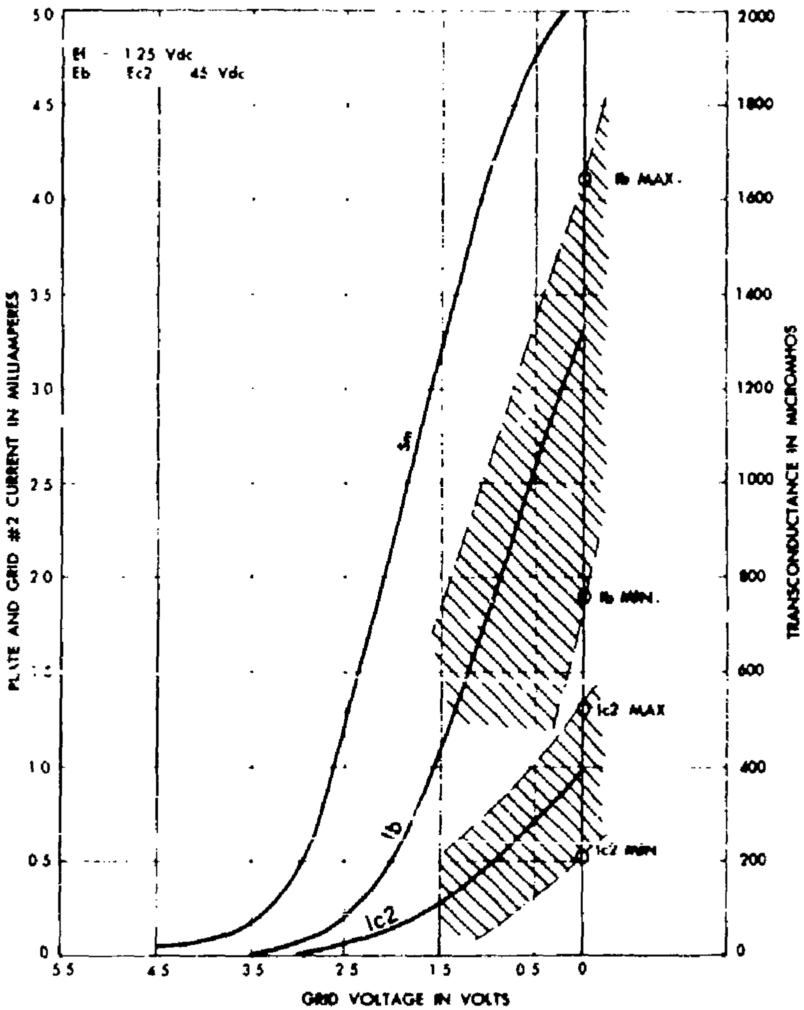


Figure 3-27. Limit Transfer Characteristics of Tube ·pe JAN 1AD4; Variability of Ib and Ic2.

3.6.17 DESIGN CENTER CHARACTERISTICS.

3.6.18 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.6.19 The chart below presents the Static Plate Characteristics of JAN-1AD4.

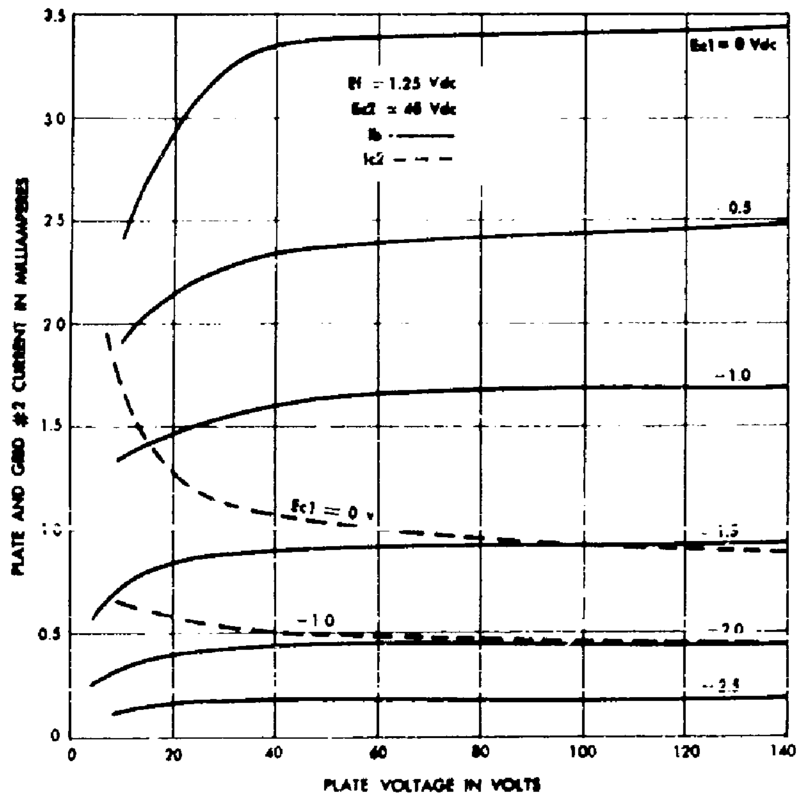


Figure 3-28. Typical Static Plate Characteristics for Tube Type JAN-1AD4

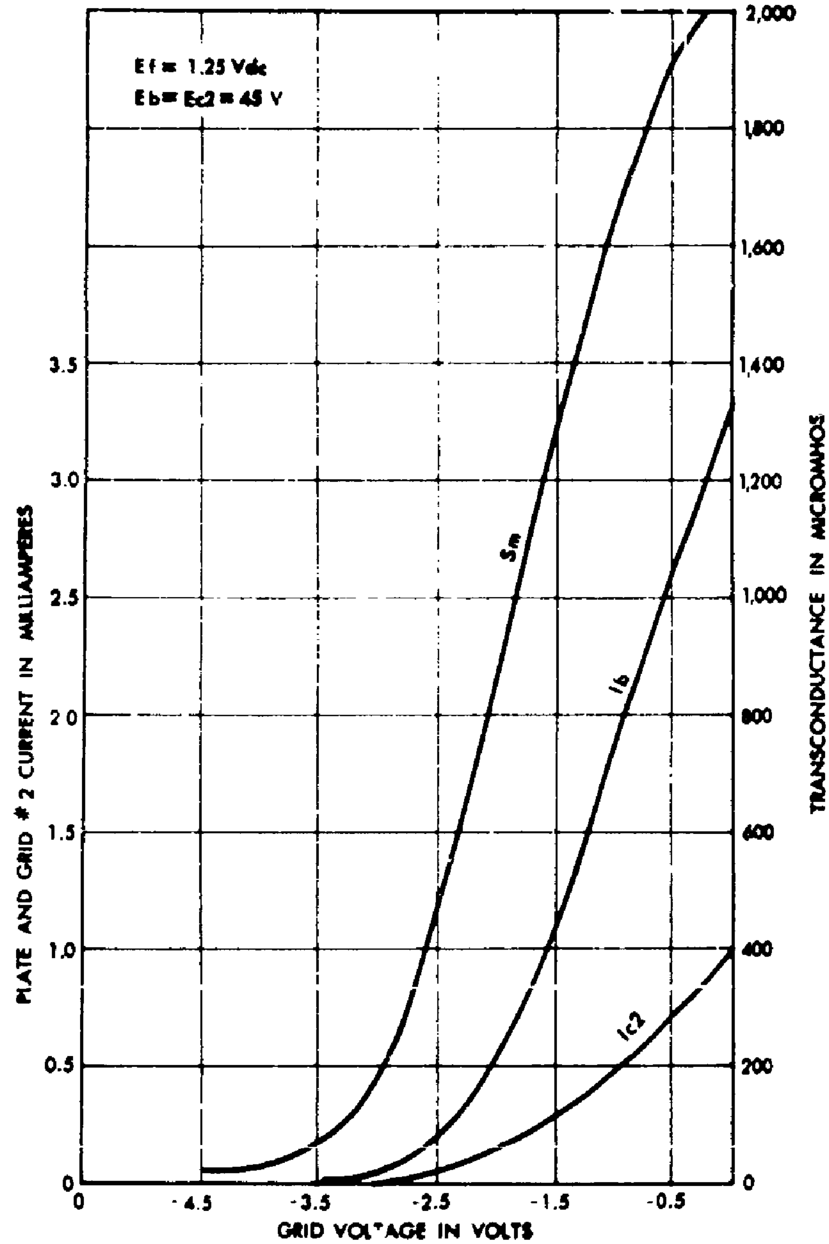


Figure 3-29. Typical Transfer Characteristics of Tube Type JAN-1AD4

SECTION 7

TUBE TYPE JAN-1AH4

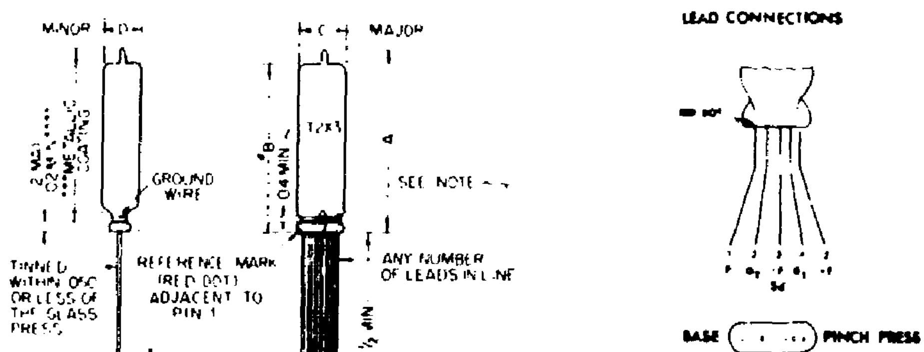
3.7 DESCRIPTION.

3.7.1 The JAN-1AH4 1/ is a 5 lead pinch press, subminiature, pentode with a metallic shield coating.

3.7.2 ELECTRICAL. The electrical characteristics are as follows:

Filament Voltage . . . . 1.25 Vdc
Filament Current . . . . 36-44 mA
Cathode . . . . Coated Filament

3.7.3 MOUNTING. Not specified.



DIMENSIONS				
A MAX.	B		DIAMETER MAX.	
	DIM	TOL ±	C MAX	D MAX
1 500	1 300	.100	385	.285

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF 210 ± 001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE 003 INCREASE OVER THE ACTUAL LEAD DIAMETER

*** WHEN SPECIFIED ON THE TSS

**** APPLIES TO PINCH PRESS TYPES ONLY (02 MIN.)

† GROUND LEAD OVERLAPPED BY SHIELD BY A MINIMUM OF .04

†† SHIELD TO GROUND WIRE MAY BE FROM EITHER SIDE OF THE MAJOR DIMENSION ALTERNATIVE CONSTRUCTION UNUSED OR EXTRA RANDOM LEAD IN PRESS OR BUTTON MAY BE FOLDED BACK AND WRAPPED AROUND BULB TO MAKE CONTACT WITH SHIELD

Figure 3-30. Outline Drawing and Base Diagram of Tube Type JAN-1AH4

1/ The values and specification comments presented in this Section are related to MIL-E-1/316 dated 14 August 1953.

3.7.4 RATING, ABSOLUTE SYSTEM.

3.7.5 The absolute system ratings are as follows:

Filament Voltage . . . . 1.25 ± 0.25 Vdc
* Plate Voltage . . . . 100 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
* Screen Grid Voltage . . . . 100 Vdc
* Altitude Rating . . . . 10,000 ft

3.7.6 TEST CONDITIONS.

3.7.7 Test conditions are as follows:

Heater Voltage, Ef . . . . 1.25 Vdc
Plate Voltage, Eb . . . . 45 Vdc
Control Grid Voltage, Ec1 . . . . 0 Vdc
Screen Grid Voltage, Ec2 . . . . 45 Vdc
Control Grid Series Resistor. . . . . 5 Meg

3.7.8 ACCEPTANCE TEST LIMITS.

3.7.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to

TABLE 3-7. ACCEPTANCE TEST LIMITS OF JAN-1AH4

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		36	44	---	---	mA
Transconductance (1)	Sm		550	950	400	---	umhos
Transconductance (2)	Sm	Ef = 1.0 V	450	---	---	---	umhos
Plate Current	Ib		0.45	1.1	---	---	mAdc
Screen Grid Current	Ic2		0.12	0.28	---	---	mAdc
Capacitance	Cgp		---	0.01	---	---	uuf
	Cin		2.7	4.2	---	---	uuf
	Cout		3.8	5.2	---	---	uuf
Grid Current	Ic1	Ec1 = -0.5 Vdc Rg1 = 0.5 Meg. Max	---	-0.5	---	-1.0	uAdc

* No test of operation at this rating exists in the specification.

include all the properties for which measurement limits are provided. Specification MIL-E-1/316 dated 14 August 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.7.10 APPLICATION.

3.7.11 The chart below shows the permissible operating area for JAN-1AH4 as defined by the ratings in MIL-E-1/316, dated 14 August 1953. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7 of this manual.

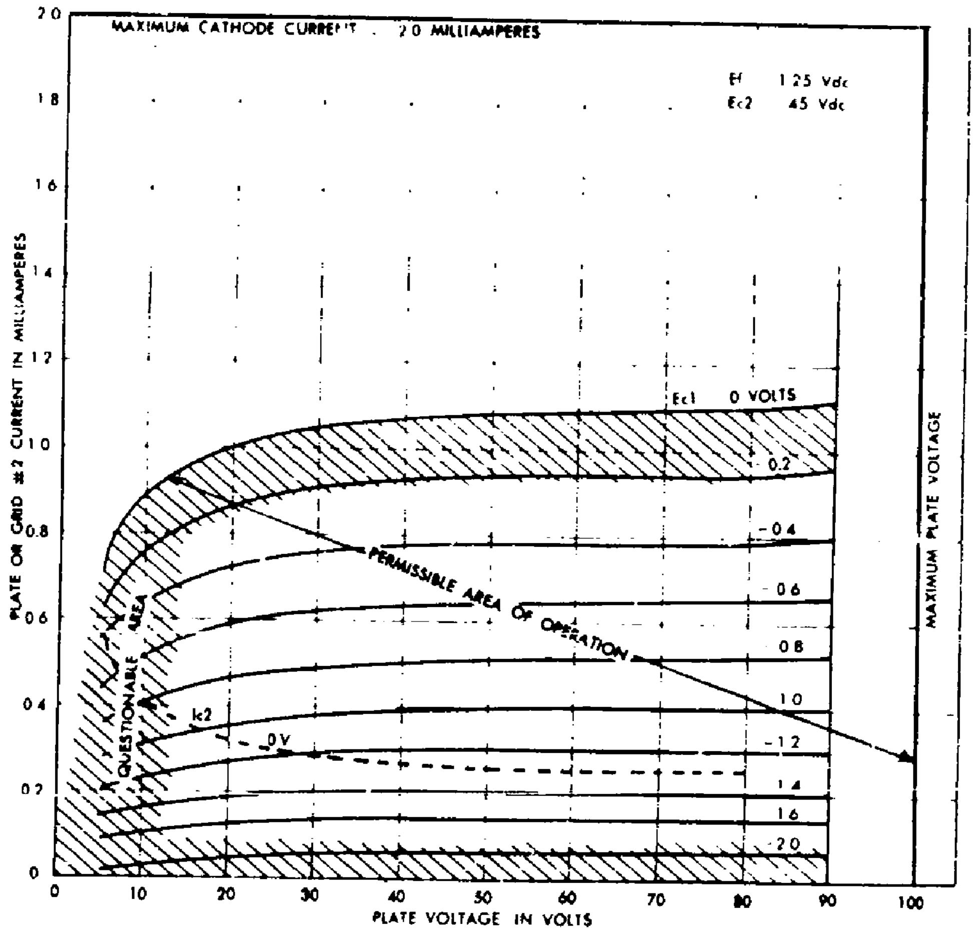


Figure 3-31. Typical Static Characteristics of Tube Type JAN-1AH4; Permissible Area of Operation

3.7.12 The following table lists general considerations for the application of this type. The paragraph numbers refer to the applicable section or paragraph of this manual.

TABLE 3-8. APPLICATION PRECAUTIONS OF JAN-1AH4

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15
- Fixed, 1.3.8, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19

Shielding, 3.2.4

Intermittent Operation, 3.2.13

Triode Connection, 3.2.20

Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.7.13 VARIABILITY OF CHARACTERISTICS.

3.7.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given in the applicable specification.

3.7.15 The limit chart on the following page presents the limit behavior of static plate characteristics for JAN-1AH4 as defined by MIL-E-1/316, dated 14 August 1953.

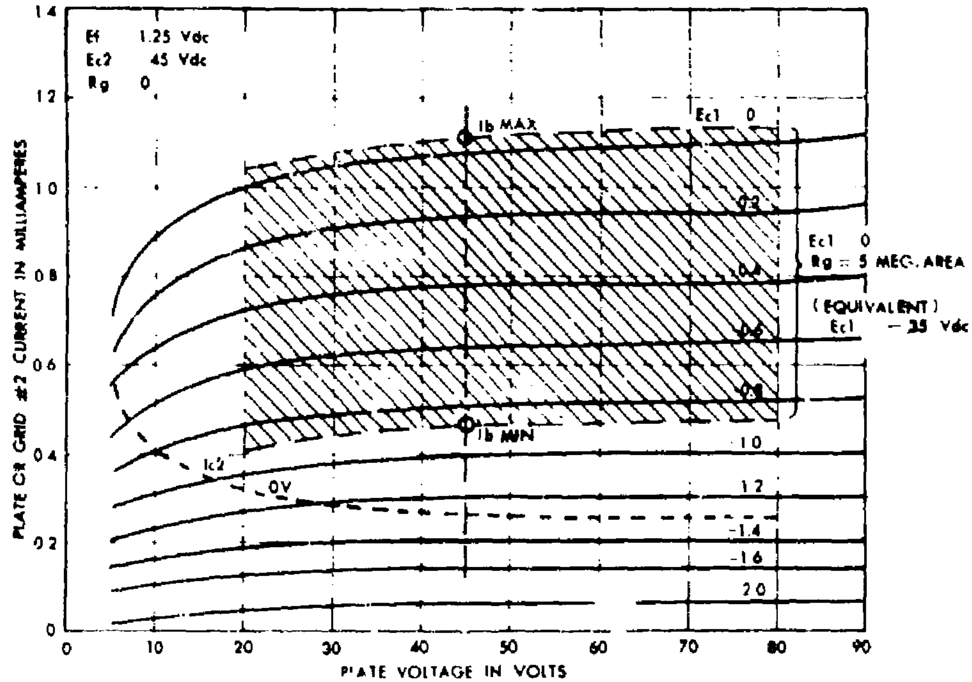


Figure 3-32. Limit Plate Characteristics of Tube Type JAN-1AH4; Variability of Ib

3.7.16 DESIGN CENTER CHARACTERISTICS.

3.7.17 These typical curves have been obtained from current data being published by the original RETMA registrant of the type.

3.7.18 The chart below presents the average transfer data for JAN-1AH4.

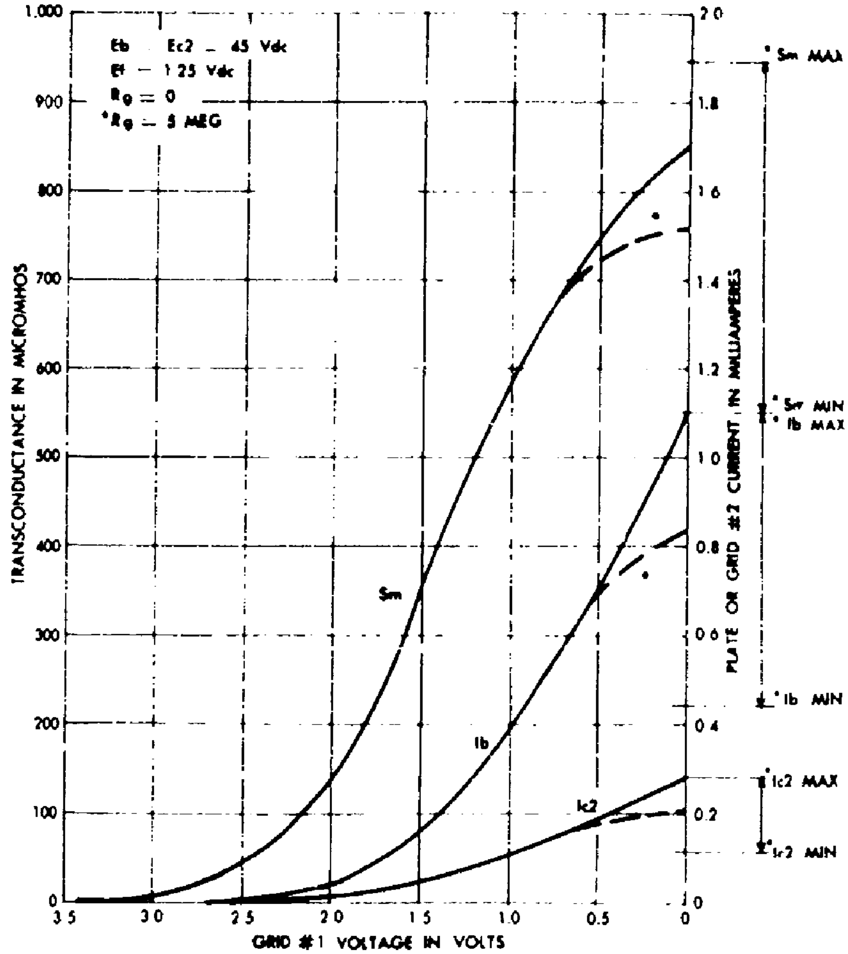


Figure 3-33. Typical Transfer Characteristics of JAN-1AH4

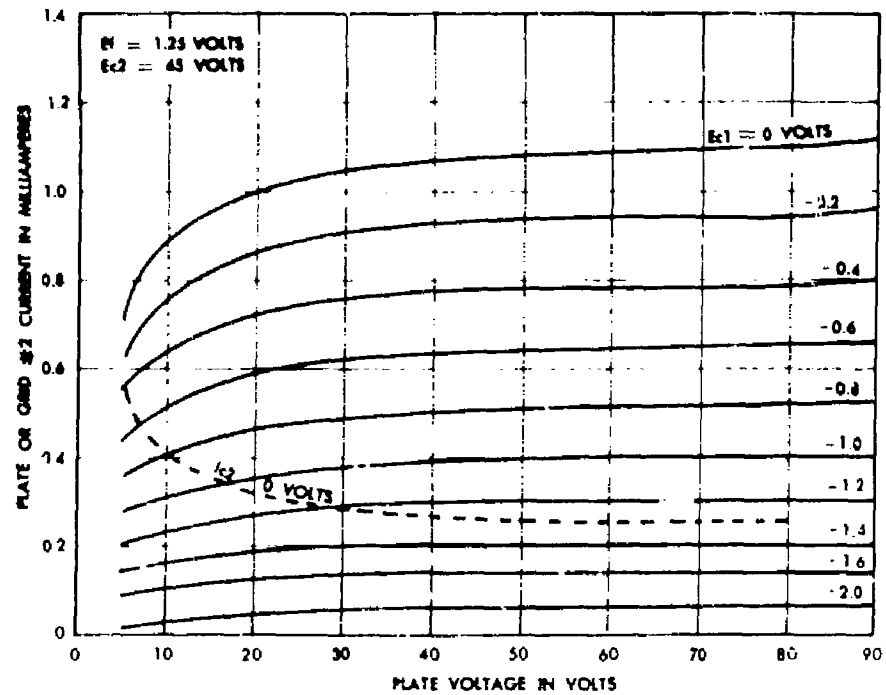


Figure 3-34. Typical Static Plate Characteristics of JAN-1AH4

SECTION 8

TUBE TYPE JAN-1B3GT

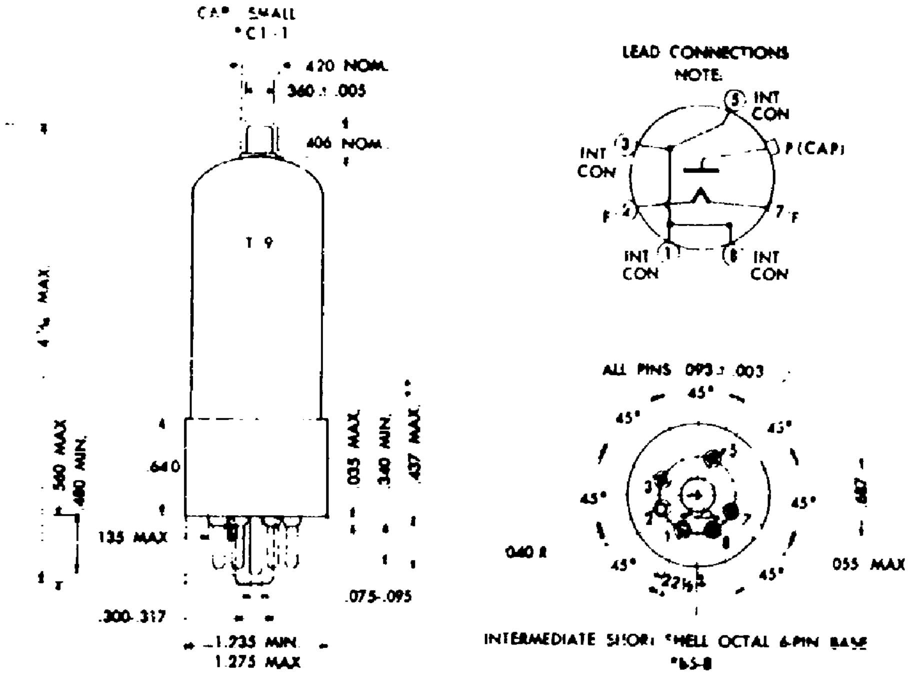
3.8 DESCRIPTION.

3.8.1 The JAN-1B3GT 1/ is a 6 pin, octal base, half-wave, high vacuum rectifier suitable in applications where the dc load current does not exceed 2.2 milliamperes.

3.8.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 1.25 Vac
Cathode . . . . Coated Filament

3.8.3 MOUNTING. Not specified.



ALL DIMENSIONS IN INCHES

*REFERS TO JETEC PUBLICATION JO G3-1, FEBRUARY 1949

**ON FINISHED TUBE, ADD 0.030 FOR SOLDER

NOTE: CONNECTING PINS 1, 3, 5 AND 8 TO PIN 7 EXTERNALLY IS PERMISSIBLE TO REDUCE CORONA DISCHARGE OTHERWISE PINS 1, 3, 5 AND 8 MAY NOT BE USED

Figure 3-35. Outline Drawing and Base Diagram of Tube Type JAN-1B3GT

1/ The values and specification comments presented in this section are related to MIL-E-1/748A dated 23 December 1955.

3.8.4 RATINGS, ABSOLUTE SYSTEM.

3.8.5 The absolute system ratings are as follows:

Heater Voltage	1.25 Vac ± 10%
Peak Inverse Plate Voltage	33 Kv
Peak Anode Current	18.7 ma
Output Current	2.2 mAdc
Minimum supply source impedance (at maximum voltage and current ratings)	105,000 ohms
* Frequency	300 KC
* Altitude Rating	10,000 ft

3.8.6 TEST CONDITIONS.

3.8.7 Test conditions are as follows:

Heater Voltage, Ef	1.25 Vac
Peak Inverse Plate Voltage, epx	33 Kv
Minimum Frequency	75 Kc

3.8.8 ACCEPTANCE TEST LIMITS.

3.8.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise in-

TABLE 3-9. ACCEPTANCE TEST LIMITS OF JAN-1B3GT

PROPERTY		MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	INITIAL MAX	LIFE TEST MIN	LIFE TEST MAX	UNITS
Filament Current	If		180	220	---	---	mA
Operation (2)	Eo	R_L = [illegible]00 Meg C_L = 400 uuf epx = 40 kv (test time not to exceed 1 minute)	17.5	---	---	---	kVdc
Emission	Is	Eb = 100 Vdc Ef = 1.10 Vdc	5.0	15.0	3.0	---	mAdc
Capacitance	Cpf		1.0	2.0	---	---	uuf

* No tests at this rating exists in the specification.

tended to include all the properties for which measurement limits are provided. Specification MIL-E-1/748A dated 23 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

3.8.10 APPLICATION.

3.8.11 RATING CHARTS.

3.8.12 Rating Charts I, II, and III represent areas of permissible operation within which any application of the JAN-1B3GT must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.8.13 RATING CHART I is based on maximum rated peak inverse voltage per plate (epx) of 33 kilovolts and maximum rated dc output current (Io) of 2.2 milliamperes. Point C corresponds to the simultaneous occurance of these two ratings, permissible under choke or capacitor-input filter conditions.

3.8.14 RATING CHART II for capacitor input filter applications, is based on maximum rated dc output current (Io) and maximum rated steady state peak plate current of 18.7 milliamperes. Rectification efficiency must not exceed 0.85 under conditions of maximum rated dc output current.

3.8.15 RATING CHART III for capacitor input filter is based on a maximum allowable surge current (i surge) of 150 milliamperes, as derived from the specification. Minimum permissible series resistance (Rs) is approximately 105,000 ohms under conditions of maximum peak inverse voltage and current ratings.

3.8.16 OTHER CONSIDERATIONS.

3.8.17 CORONA DISCHARGE: Connecting pins 1, 3, 5, and 8 to pin 7 externally is permissible to reduce corana discharge, otherwise, pins 1, 3, 5 and 8 may not be used.

3.8.18 HEATER VOLTAGE: See paragraph 3.3.9.

3.8.19 ALTITUDE: See paragraph 3.3.7.

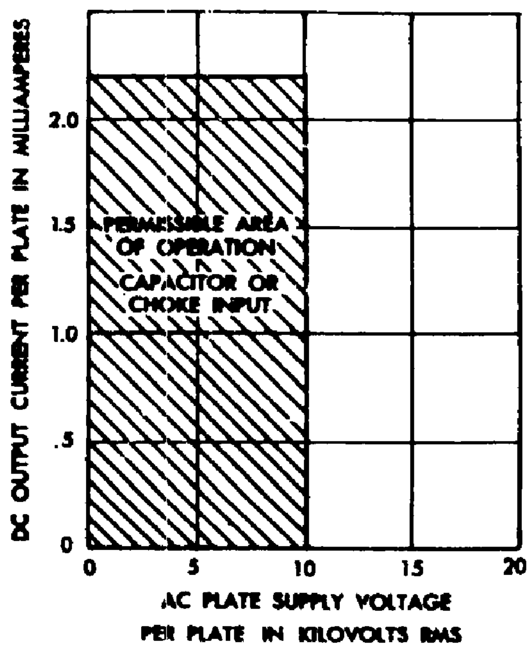


Figure 3-36. Rating Chart I for the Tube Type JAN-1B3GT

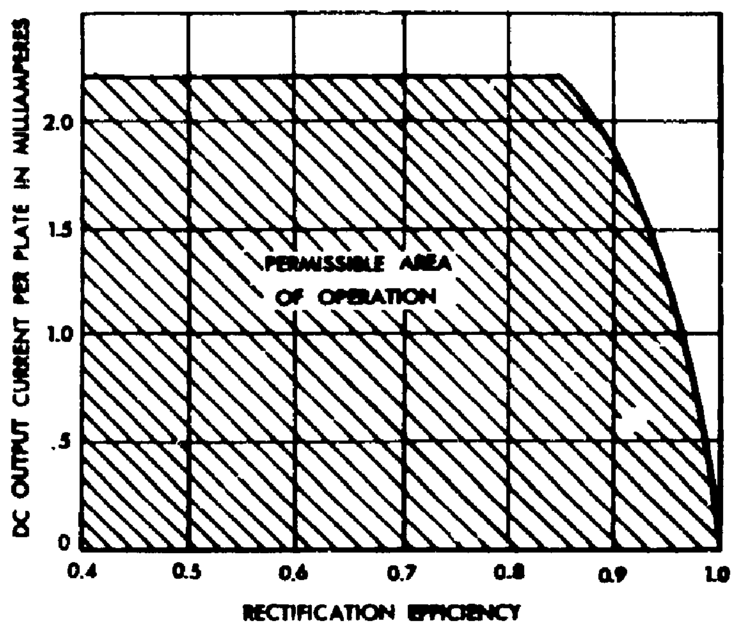


Figure 3-37. Rating Chart II for the Tube Type JAN-1B3GT

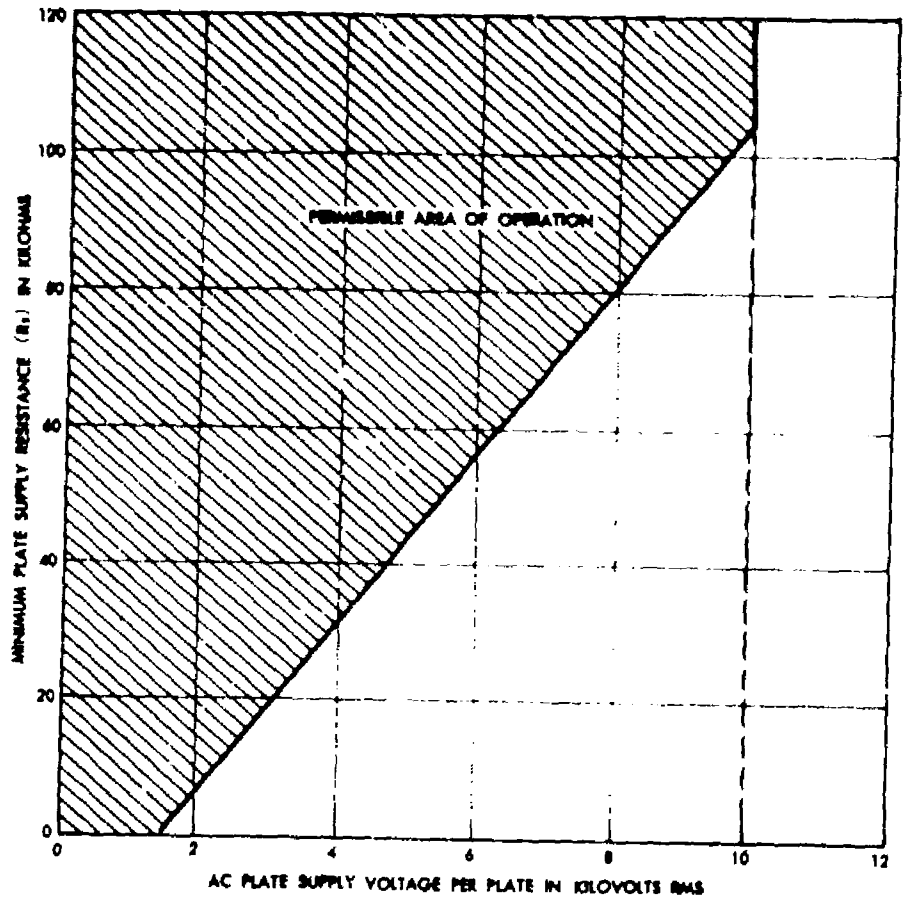


Figure 3-38. Rating Chart III for the Tube Type JAN-1B3GT

3.8.20 AVERAGE CHARACTERISTICS.

3.8.21 The chart below presents the Static Plate Characteristic of JAN-1B3GT, reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes was derived from the specification which provides minimum and maximum limits on emission, at Eb = 100 Vdc, of 5.0 and 15.0 mAdc respectively.

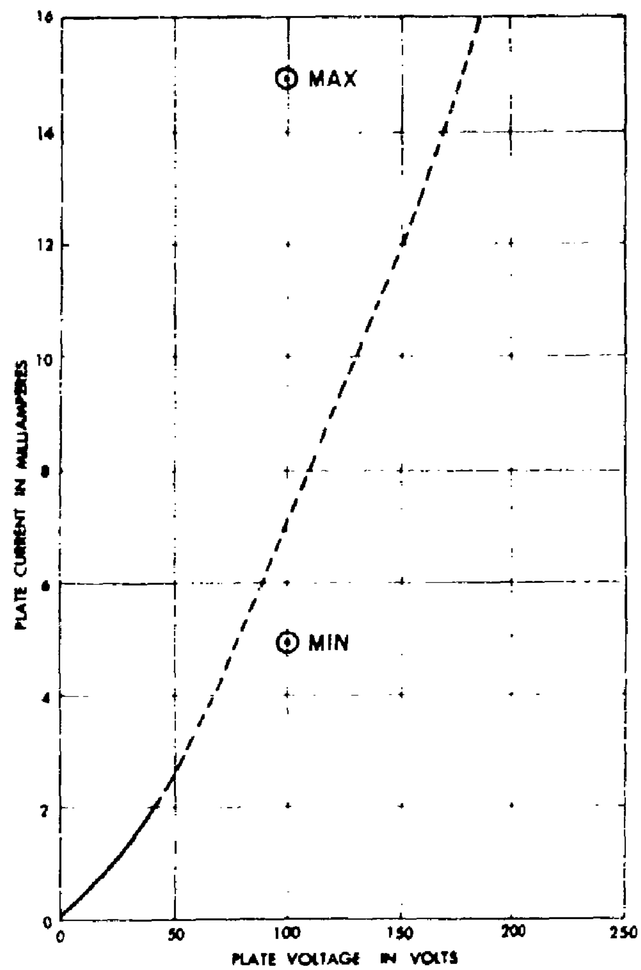


Figure 3-39. Typical Plate Characteristics of Tube Type JAN-1B3GT

SECTION 9

TUBE TYPE JAN-1Z2

3.9 DESCRIPTION.

3.9.1 The JAN-1Z2 1/ is a 7 pin button base, miniature, high vacuum rectifier (half wave).

3.9.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 1.25 V
Cathode . . . . Thoriated Tungsten

3.9.3 MOUNTING. Not specified.

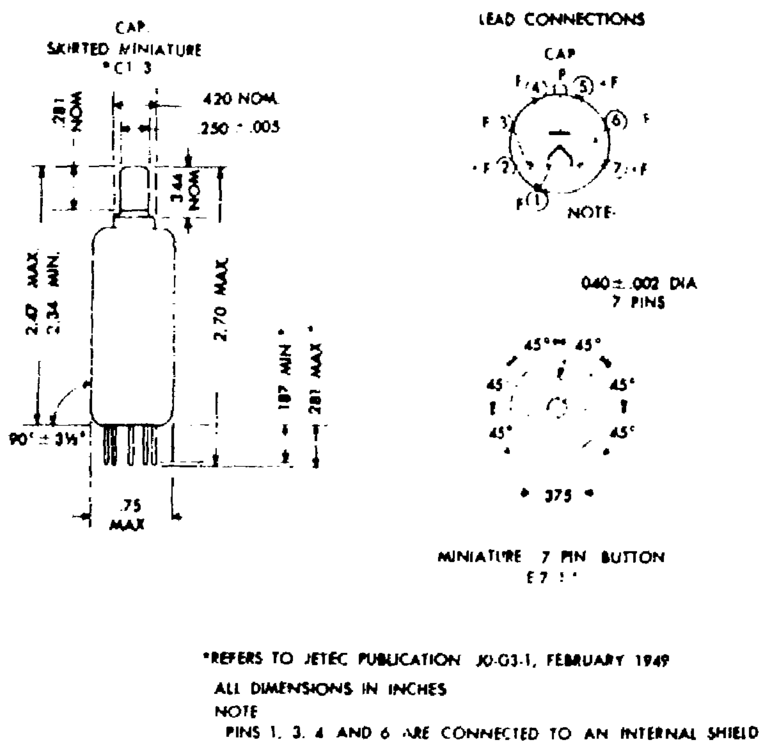


Figure 3-40. Outline Drawing and Base Diagram of Tube Type JAN-1Z2

1/ The values and specification comments presented in this section are related to MIL-E-1/29 dated 5 February 1953.

3.9.4 RATING, ABSOLUTE SYSTEM.

3.9.5 The absolute ratings are as follows:

* Maximum Frequency	200 Kc
Heater Voltage	1.25 Vac ± 5%
Peak Inverse Plate Voltage	15 kv
Steady State Peak Plate Current, ib	8.5 ma
Output Current	1.5 mAdc
* Altitude Rating	10,000 ft

3.9.6 TEST CONDITIONS.

3.9.7 Test conditions are as follows:

Heater Voltage, Ef	1.25 Vac
Peak Inverse Plate Voltage, epx	15 kv
Load Resistance, RL	4.2 meg
Load Capacitance, CL	0.01 uf
Output Current, Io	1.5 mAdc

3.9.8 ACCEPTANCE TEST LIMITS.

3.9.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. The table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/29 dated 5 February 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

TABLE 3-10. ACCEPTANCE TEST LIMITS OF JAN-1Z2

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Filament Current	If		245	285	---	---	mA
Emission	Is	Ef =1.35 V Eb = 100 Vdc	9.5	---	8.5	---	mAdc

3.9.10 APPLICATION.

3.9.11 RATING CHARTS.

* No test at this rating exists in the specification.

3.9.12 Rating Charts I, II, and, III represent areas of permissible operation within which any application of the JAN-1Z2 must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.9.13 RATING CHART I is based on maximum rated peak inverse voltage (epx) of 15 kilovolts and maximum rated dc output current (Io) of 1.5 milliamperes. Point C is derived from like test conditions of max rated dc output current, peak inverse plate voltage, and steady state peak plate current.

3.9.14 RATING CHART II for capacitor input filter applications, is based on maximum rated dc output current (Io) and maximum rated steady state peak plate current of 8.5 milliamperes per plate. Rectification efficiency must not exceed 0.65 under conditions of maximum rated dc output current.

3.9.15 RATING CHART III for capacitor input filter is based on maximum surge current (i surge) of 25 milliamperes, as derived from specification minimum permissible source impedance of 300,000 ohms under conditions of maximum permissible supply voltage.

3.9.16 OTHER CONSIDERATIONS.

3.9.17 HEATER VOLTAGE: See paragraph 3.3.9.

3.9.18 ALTITUDE: See paragraph 3.3.7.

3.9.19 AVERAGE CHARACTERISTICS.

3.9.20 Figure 3-44 presents the Static Plate Characteristic of JAN-1Z2, reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification which provides only a minimum limit on emmission.

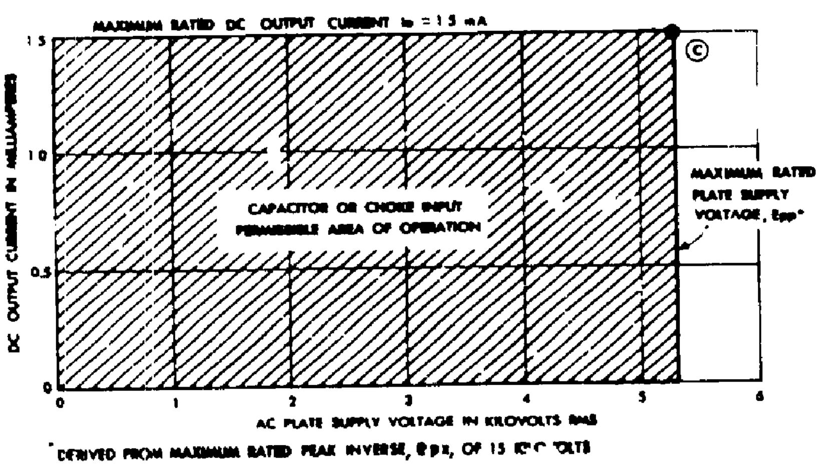


Figure 3-41. Rating Chart I for the Tube Type JAN-1Z2

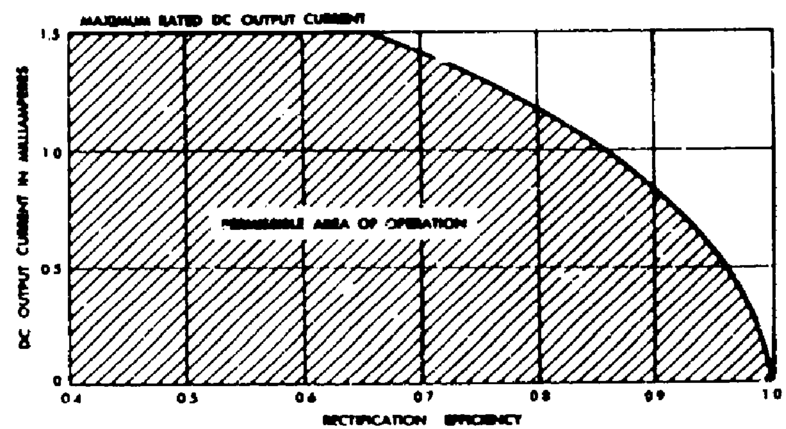


Figure 3-42. Rating Chart II for Tube Type JAN-1Z2

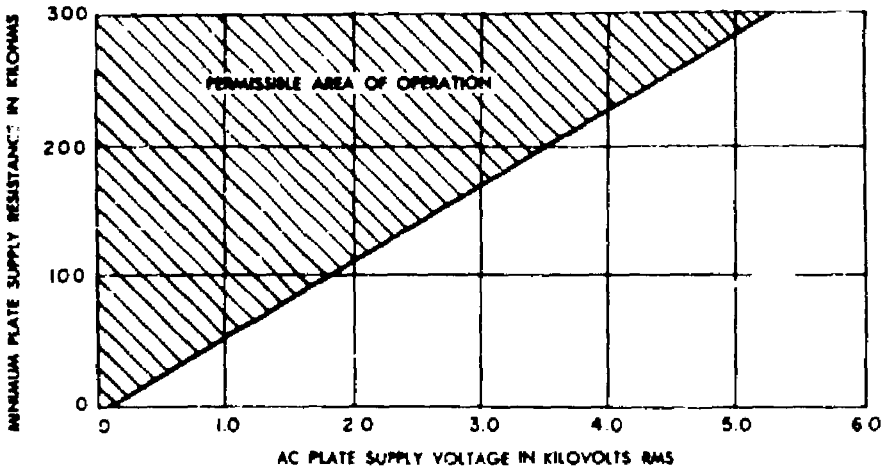


Figure 3-43. Rating Chart III for JAN-1Z2

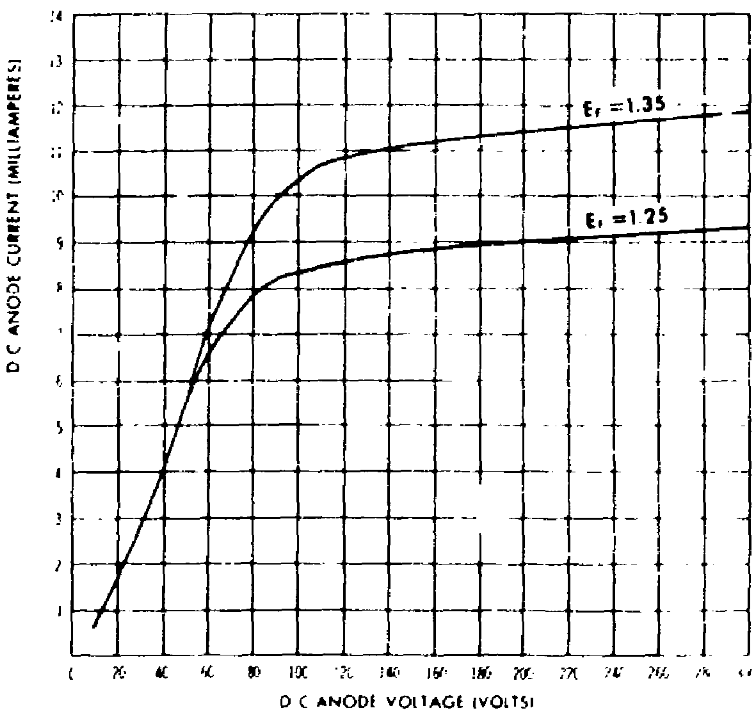


Figure 3-44. Typical Plate Characteristics for JAN-1Z2

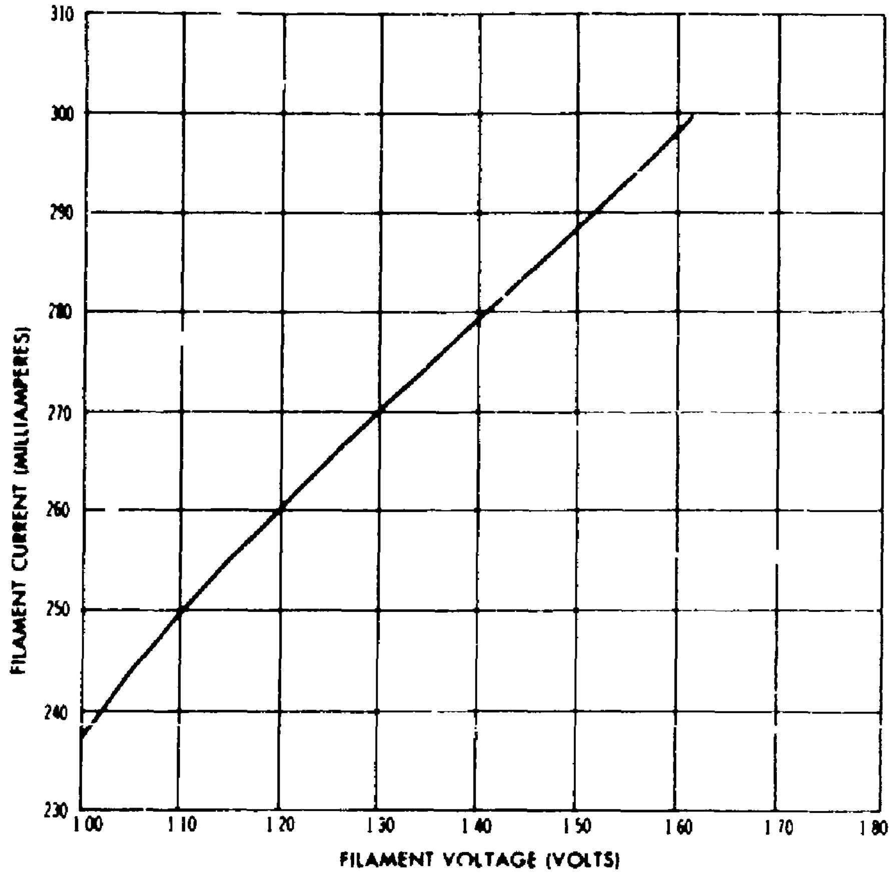


Figure 3-45. Typical Filament Characteristics for JAN-1Z2

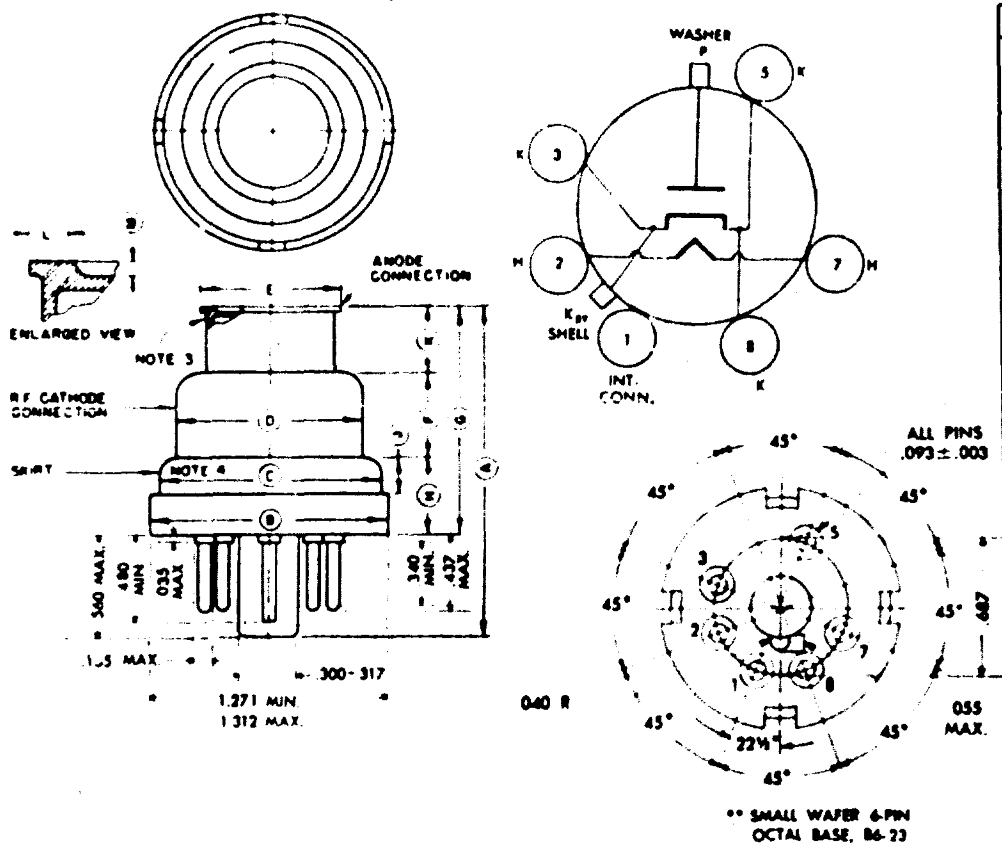
TUBE TYPE JAN-2B22

3.10 DESCRIPTION.

3.10.1 The JAN-2B22 1/ is a 6 pin, octal base, U.H.F. diode.

3.10.2 ELECTRICAL. The electrical characteristics are as follows:
Heater Voltage . . . . 6.3 Vac
Cathode . . . . Coated Unipotential

3.10.3 MOUNTING. Not specified.



REF.	DIMENSION	
	MIN.	MAX.
**A		1 5/16
**B		1.312 DIA.
**C	1.216 DIA.	1.236 DIA.
*D	1.023 DIA.	1.039 DIA.
*E	.806 DIA.	.818 DIA.
*F	.475	.505
*G		1.350
**H	.395	.455
**J	.180	.210
*K	.360	.390
**L	1/16	
**M	.013	.027

**Note 1 Silver plate external surface of metal parts, except base pins. MIN .100 MS1.

*Note 2 Cathode RF connection & anode connection shall be concentric with respect to each other within 0.020.

Note 3 Glass shall not extend beyond edge of anode.

Note 4 Tolerance does not apply to point where skirt is crimped.

Note 5 Skirt shall not be used RF contact surface.

Figure 3-46. Outline Drawing and Base Diagram of Tube Type JAN-2B22

1/ The values and specification comments presented in this section are related to MIL-E-1/736 dated 17 December 1954.

3.10.4 RATINGS, ABSOLUTE SYSTEM.

3.10.5 The absolute system ratings are as follows:

Maximum Frequency at which maximum ratings apply	F1, 1200 Mc
Heater Voltage	6.3 ± 5% Vac
** Peak Plate Voltage	100 v
Peak Inverse Plate Voltage	300 v
Heater-Cathode Voltage	100 v
** Steady State Peak Plate Current	1.0 a
Plate Current	20 mAdc
Output Voltage	150 Vdc
Cathode Conditioning Time, tk	60 Sec
* Seal Temperature	200° C
* Altitude Rating	10,000 ft

3.10.6 TEST CONDITIONS.

3.10.7 Test Conditions are as follows:

Heater Voltage, Ef	6.3 Vac
Plate Current	20 mAdc
Cathode Conditioning Time	300 Sec

3.10.8 APPLICATION.

3.10.9 SIGNAL RECTIFIER SERVICE: In the application of the JAN-2B22 in UHF signal rectifier service, specification MIL-E-1/736 dated 17 December 1954 prescribes that the maximum ratings are applicable up to a maximum frequency of 1200 megacycles, though no performance tests are specified in the UHF region. It should be noted that the specification prescribes also that the JAN-2B22 shall not be operated more than 5 microseconds in a 100 microsecond interval, under conditions of maximum rated peak plate voltage or maximum rated peak plate current.

3.10.10 Permissible steady state peak plate voltage is limited to 100 volts, and peak plate current to 1.0 ampere, under these conditions. When used in reference to pulses the maximum rated peak plate current excludes the current spike. An additional restriction should be borne in mind by designers - - a minimum cathode conditioning time (tk) of 60 seconds must be allowed before the application of high voltage.

3.10.11 SUPPLY VOLTAGE RECTIFIER SERIVCE: Not applicable.

3.10.12 OTHER CONSIDERATIONS.

3.10.13 HEATER VOLTAGE: See paragraph 3.4.8.

3.10.14 LOW ELECTRODE CURRENT: See paragraph 3.4.7.

---

* No test at this rating exists in the specification.

** Tube shall not be operated more than 5 usec in a 100 usec interval.

3.10.15 ACCEPTANCE TEST LIMITS.

3.10.16 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/736 dated 17 December 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-11. ACCEPTANCE TEST LIMITS OF JAN-2B22

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		700	800	---	---	mAdc
Tube Drop	Etd	Ib = 20 mAdc	3.0	9.0	---	10.0	Vdc
Pulse Emission Voltage	eb	Is = 0.90a; tp = 2us prr = 500	---	150	--	---	v
Capacitance	Cout	Ef = 0	1.9	2.4	---	---	uuf
Heater-Cathode Leakage	Ihk	Ehk = 100 Vdc	---	-20	---	---	uAdc
	Ihk	Ehk = -100 Vdc	---	-50	---	---	uAdc
Insulation of Electrodes	Rpsh		25	---	---	---	Meg

SECTION 11

TUBE TYPE JAN-2C40

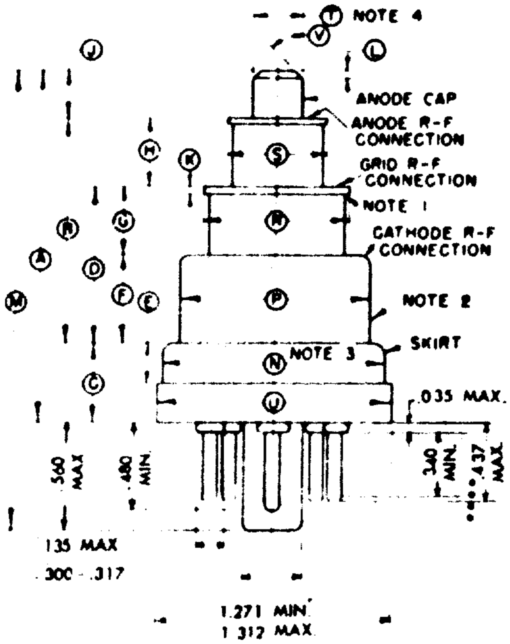
3.11 DESCRIPTION.

3.11.1 The JAN-2C40 1/ is a six pin octal base disc seal triode amplifier and oscillator with an indirectly heated cathode.

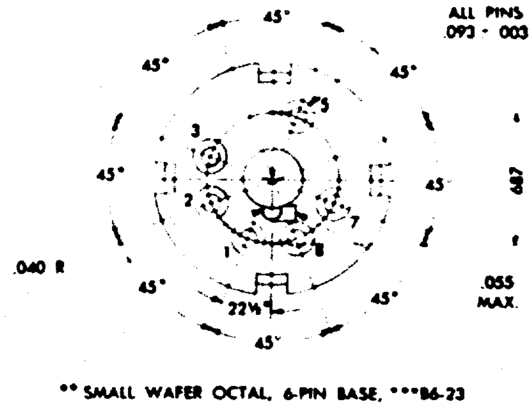
3.11.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 Vac
Cathode . . . . Coated Unipotential

3.11.3 MOUNTING. Not specified.

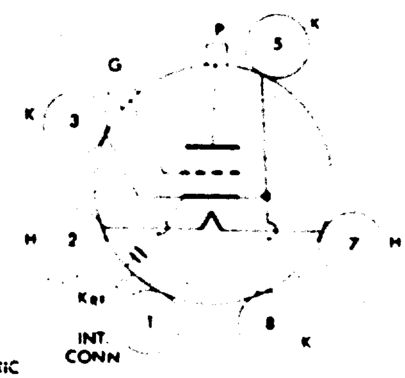


REF	DIMENSION MIN	MAX	NOM
*A		1.973	
*B	1.220	1.260	
C	.395	.455	
*D	.850	.880	
E	.180	.210	
*F	.475	.505	
*G	.360	.390	
H	.360	.390	
*J	.242	.258	
K	.030	.035	
L		3/64	
M		2 2/16	
N	1.216	1.236	
*P	1.023	1.039	
*R	.8085	.8155	
S	.557	.567	
*T	.248	.252	
U		1.312	
V			45°



** SMALL WAFER OCTAL, 6-PIN BASE, ***B6-23

LEAD CONNECTIONS



NOTES:

*1 GLASS SHALL CONFORM WITH REQUIREMENTS OF DETAIL A.
*2 CATHODE R-F CONNECTION SURFACE SHALL BE FREE FROM WELDING FLASH MATERIAL.
3 TOLERANCE DOES NOT APPLY AT POINTS WHERE SKIRT IS CRIMPED TO BASE
4 A 3/64 MAX. RADIUS CHAMFER MAY BE USED INSTEAD OF BEVEL.
**5 EXTERNAL SURFACE OF METAL PARTS, EXCEPT PINS, SHALL BE SILVER PLATED 100 MS1 MIN.
*6 THE ANODE CAP GRID R-F CONNECTION AND THE CATHODE R-F CONNECTION SHALL BE CONCENTRIC WITH RESPECT TO EACH OTHER WITHIN 1/64.
7 TEST SHALL BE MADE ON TEN TUBES PER MONTH WHEN IN CONTINUOUS PRODUCTION, FAILURE OF MORE THAN ONE TUBE TO MEET THE TOLERANCE FOR ANY OF THESE DIMENSIONS, SHALL CAUSE THAT DIMENSION TO BECOME A DESIGN ON ALL LOTS IN PROCESS.
***REFERS TO JETEC PUBLICATION J0-G3-1, FEBRUARY 1949
****ON FINISHED TUBE, ADD 0.030 FOR SOLDER
ALL DIMENSIONS IN INCHES

Figure 3-47. Outline Drawing and Base Diagram of Tube Type JAN-2C40

1/ The values and specification comments presented in this section are related to MIL-E-1/737 dated 17 December 1954.

3.11.4 RATINGS, ABSOLUTE SYSTEM.

3.11.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 5% Vac
Plate Voltage	500 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Plate Dissipation	6.5 W
Cathode Conditioning Time	60 sec. min.
Seal Temperature	200 °C
Altitude Rating	10,000 ft

3.11.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.11.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 Vac
Plate Voltage, Eb	250 Vdc
Cathode Conditioning Time	300 sec.
Cathode Resistance, Rk	200 ohms
Cathode Bypass Capacitance	1,000 uf

3.11.8 ACCEPTANCE TEST LIMITS.

3.11.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/737 dated 17 December 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-12. ACCEPTANCE TEST LIMITS OF JAN-2C40

PROPERTY		MEASUREMENT CONDITIONS	LIMIT				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		700	800	---	---	mA
Transconductance	Sm		4400	5700	---	---	umhos
Amplification Factor	Mu		27	44	---	---	---
Plate Current	Ib		13	22	---	---	mAdc
Grid Voltage	Ec	Ec/Ib = 10 uAdc	-10	-26	---	---	Vdc
Emission	Es	E_bE_c/I_k = 40 mAdc; R_k = 0	---	10	---	---	Vdc
Power Oscillation	Po	Eb = 250 Vdc max Ib = 25 mAdc max Rk = 0; Rg = 10, 000 F = 3370 Mc/sec nom	35	---	25	---	mW
Capacitance	Cgp		1. 15	1. 40	---	---	uuf
	Cin		1. 90	2. 35	---	---	uuf
	Cout		---	0. 03	---	---	uuf
	Cshk		30	200	---	---	uuf
Grid Current	Ic		0	-1. 0	---	---	uAdc
Heater-Cathode Leakage	Ihk	t = 180 sec. Ehk = +100 Vdc	---	20	---	---	uAdc
	Ihk	Ehk = -100 Vdc	---	-50	---	---	uAdc
Insulation of Electrodes	Rk - sh		25	---	---	---	Meg
	Rh - sh		25	---	---	---	Meg
	Rg - sh		25	---	---	---	Meg
	Rg - p		25	---	---	---	Meg

3.11.10 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-13. APPLICATION PRECAUTIONS FOR JAN-2C30

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
- High, 3.1.8
- Low, 3.1.15
- AC Operation, 1.3.20, 3.1.10,
- 28 Volt, 3.1.15

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.1.[illegible]
- Cathode, 2.1.3, 3.1.12
- Fixed, 1.3.8, 2.1.3, 3.1.4

Positive Grid Region, 3.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.11.11 The chart below shows the permissible operating area for JAN-2C40 as defined by the ratings in MIL-E-1/737 dated 17 December 1954. A discussion of the permissible operating area for triodes may be found in paragraphs 3.1.2 through 3.1.5.

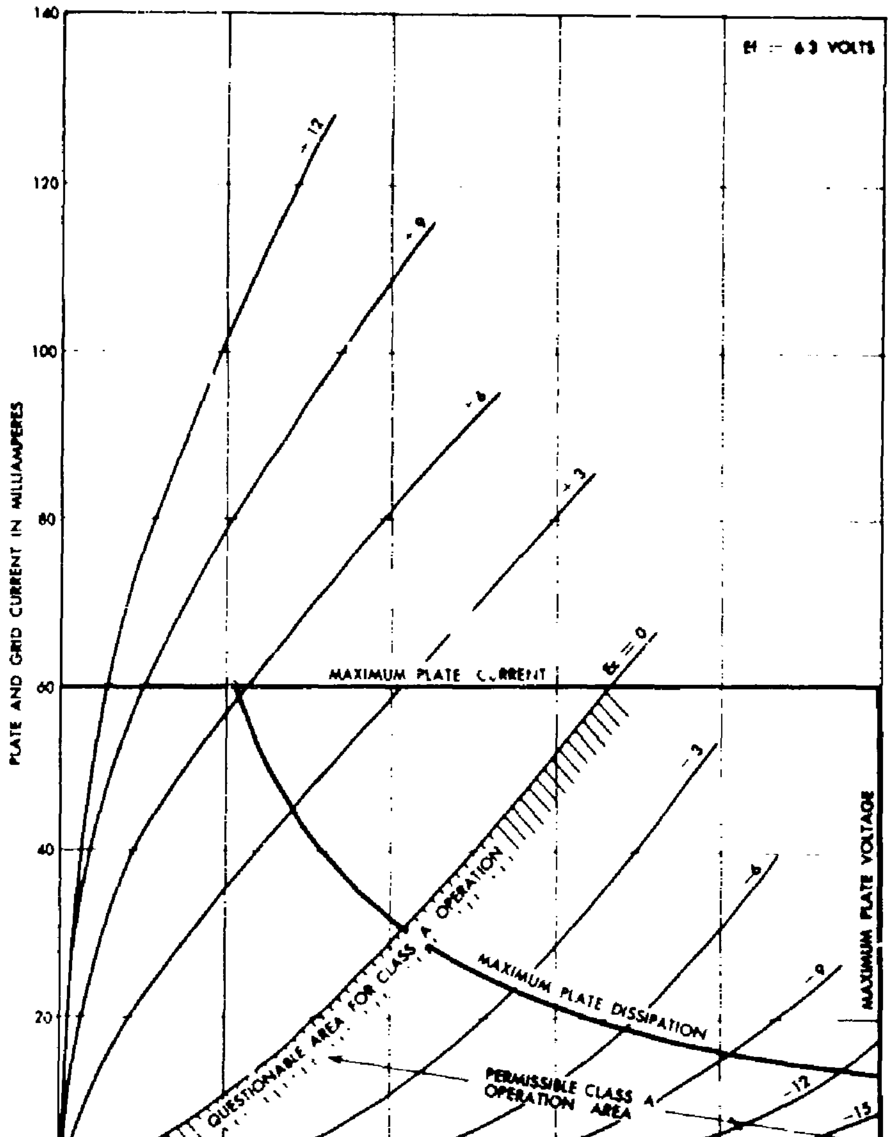


Figure 3-48. Permissible Operating Region of JAN-2C40

3.11.12 VARIABILITY OF CHARACTERISTICS.

3.11.13 The following charts show the amount of varia..on which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.11.14 The chart below presents the limit behavior of static plate characteristics for JAN-2C40 as defined by MIL-E-1/737 dated 17 December 1954.

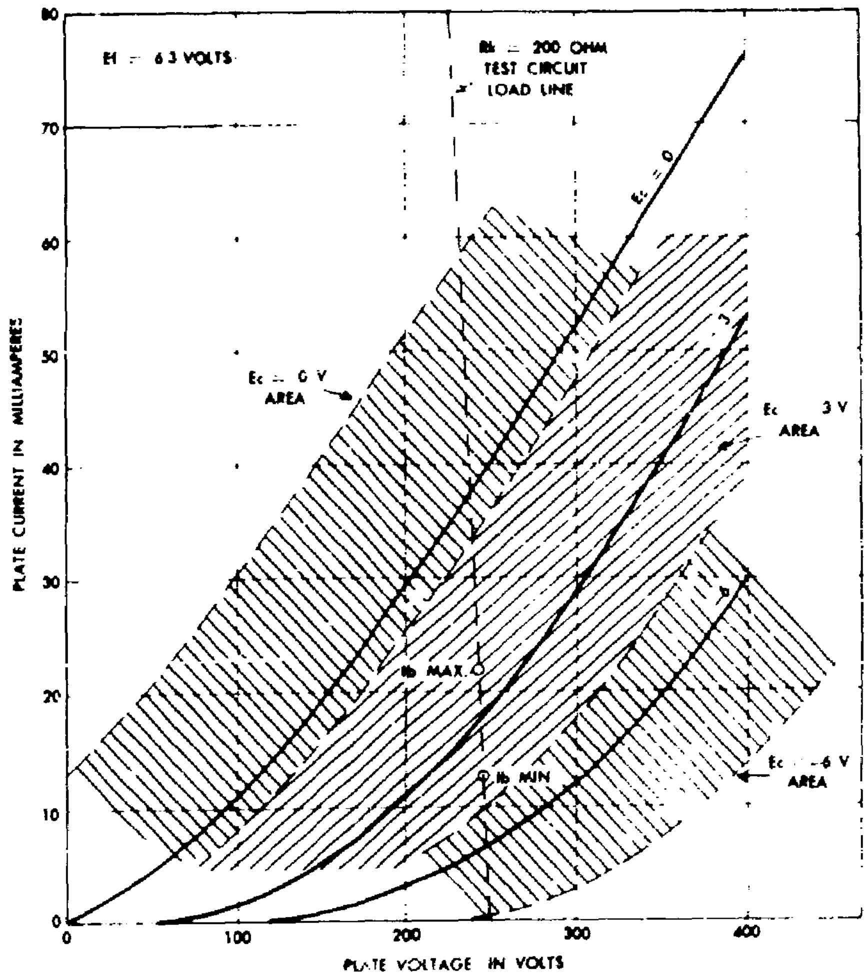


Figure 3-49. Limit Behavior of JAN-2C40; Static Plate Data

3.11.15 The chart below presents the limit behavior of transfer data for JAN-2C40 as defined by MIL-E-1/737 dated 17 December 1954.

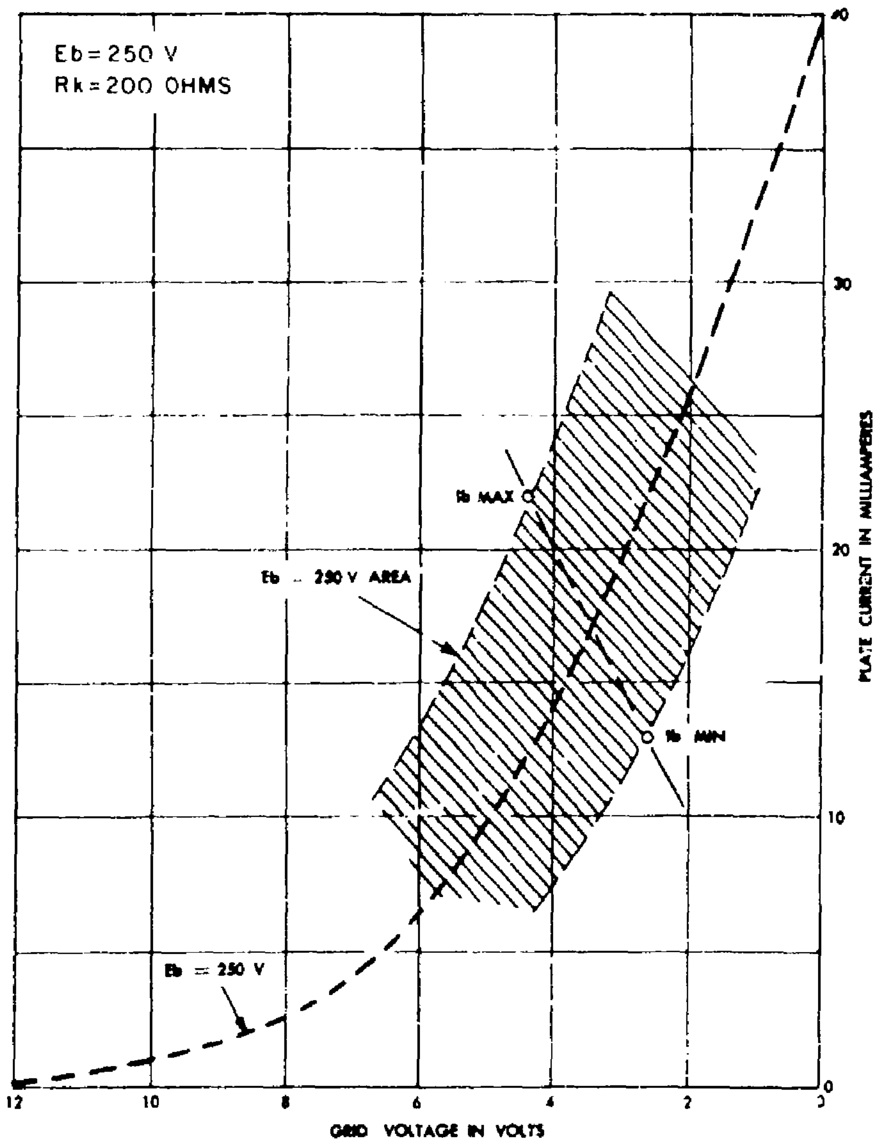


Figure 3-50. Limit Behavior of JAN-2C40, Transfer Data

3.11.16 DESIGN CENTER CHARACTERISTICS.

3.11.17 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

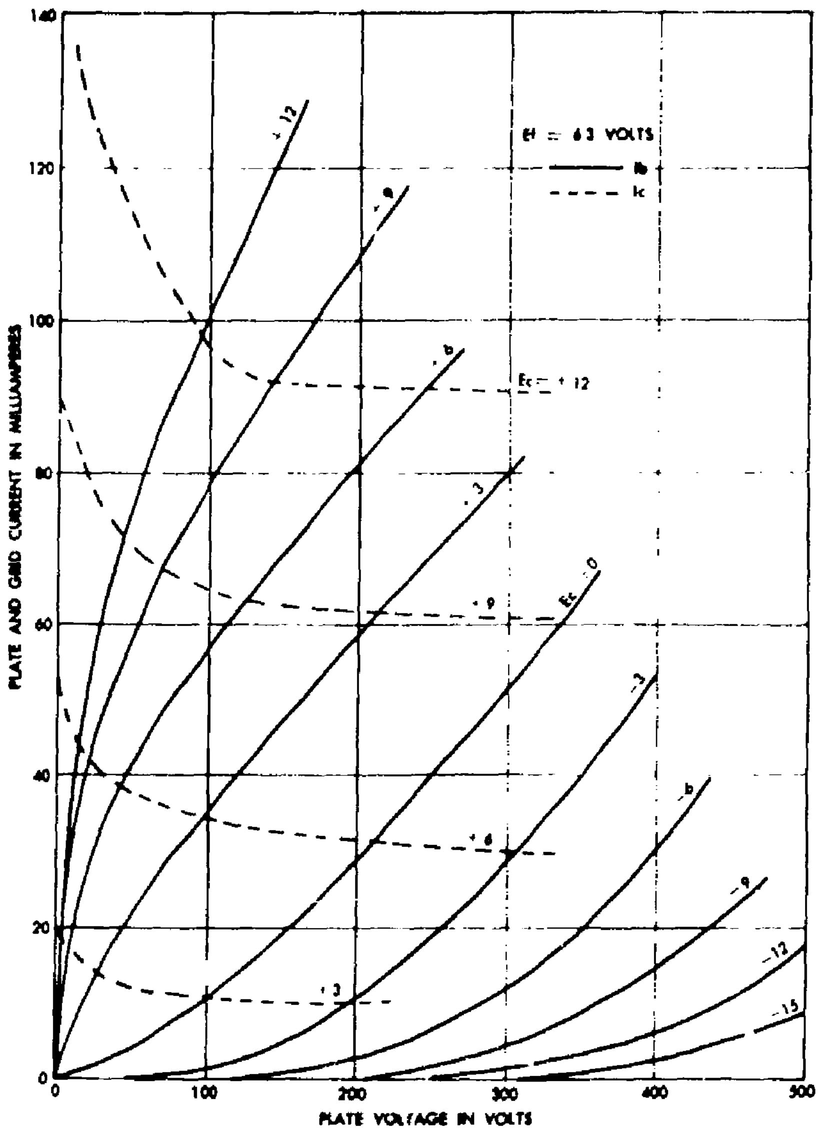


Figure 3-51. Static Plate Characteristics of JAN-2C40

Figure 3-51. Static Plate Characteristics of JAN-2C40

SECTION 12

TUBE TYPE JAN-2E30

3.12 DESCRIPTION.

3.12.1 The JAN-2E30 1/ is a 7 pin, button base, miniature instant heating beam pentode power amplifier.

3.12.2 ELECTRICAL. The electrical characteristics are as follows:

Filament Voltage, AC or DC . . . . Par. 3.0 Series 6.0 V
Filament Current, Design Center . . . . . . 585 - 715 mA
Cathode . . . . Oxide Coated Filament

3.12.3 MOUNTING. Filament plane must be vertical.

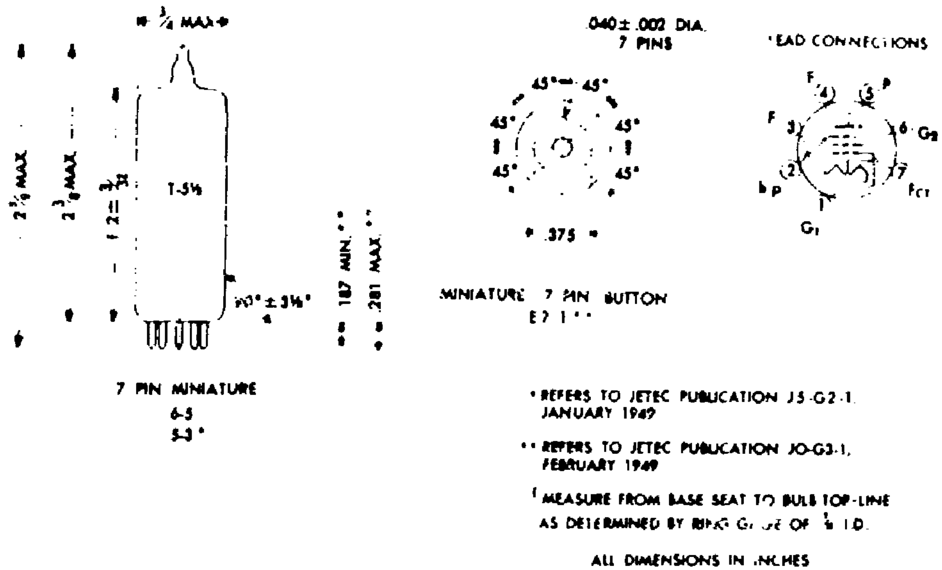


Figure 3-52. Outline Drawing and Base Diagram of Tube Type JAN-2E30

3.12.4 RATINGS, ABSOLUTE SYSTEM.

3.12.5 The absolute system ratings are as follows:

Filament Voltage . . . . Par. 3.0 ± 10%
Series 6.0 ± 10% V
Plate Voltage . . . . 250 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Control Grid Voltage, Maximum Negative Voltage -150 Vdc
Screen Grid Voltage . . . . 250 Vdc
Plate Dissipation . . . . 10 W
Screen Grid Dissipation. . . . . 2.5 W
Altitude Rating. . . . . 10,000 ft

1/ The values and specification comments presented in this section are related to MIL-E-1/32 dated 5 February 1953.

3.12.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.12.7 Test conditions and design center characteristics are as follows:

Filament Voltage, Ef	6.0 Vac
Plate Voltage, Eb	250 Vdc
Control Grid Voltage, Ec1	-20 Vdc
Screen Grid Voltage, Ec2	250 Vdc

3.12.8 ACCEPTANCE TEST LIMITS.

3.12.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/32 dated 5 February 1953 should be referenced to determine further assurance of satisfactory operation in any specific application.

3.12.10 Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.12.11 Tests performed on this tube indicate that it is suitable for use in Class C circuitry as an oscillator, amplifier or doubler at frequencies up to 160 mc.

TABLE 3-14. ACCEPTANCE TEST LIMITS OF JAN-2E30

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Filament Current	If	Ef = 6 V	585	715	---	---	mA
Transconductance	Sm		3500	5000	---	---	umhos
Grid Current	Ic1	Measuring time t = 120 Sec.	0	-5	---	---	uAdc
Screen Grid Current	Ic2		---	5.5	---	---	mAdc
Plate Current	Ib		28	52	---	---	mAdc
Amplification Factor G1-G2	Mu	Tie screen to plate	6.6	8.6	---	---	
Class C Doubler	Pg	F = 160 mc eg = 70 v. Load and Rgl/Max Po at Ib = 50 mAdc	1.2	---	---	---	W
Primary Screen Emission	Isc2	Eb = 0; Ec2 = 127 Vac; Ecl/Pg2 = 2.5 W; measuring time t = 120 sec	---	100	---	---	uAdc
Operation Output Load Current	Ip	Ebb = 250 Vdc Eccl = 0; RL = 750; Egl = 90 Vac; Rgl = 35,000	90	---	---	---	mA
Operation Screen Current	Ic2	Ebb = 250 Vdc; Eccl = 0; RL 750; Egl = 90 Vac; Rgl = 35,000	---	20	---	20	mAdc
Activity	$\frac{\Delta Ip}{Ef}$	Ef = 5.4 Vdc	---	5	---	10	%
Capacitance (Unshielded)	Cgp	Ef = 0	---	0.2	---	---	uuf
	Cin	Ef = 0	8.2	10.2	---	---	uuf
	Cout	Ef = 0	6.3	8.3	---	---	uuf

3.12.12 APPLICATION

3.12.13 The chart below shows the permissible operating area for JAN-2E30 as defined by the ratings in MIL-E-1/32 dated 3 February 1953. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

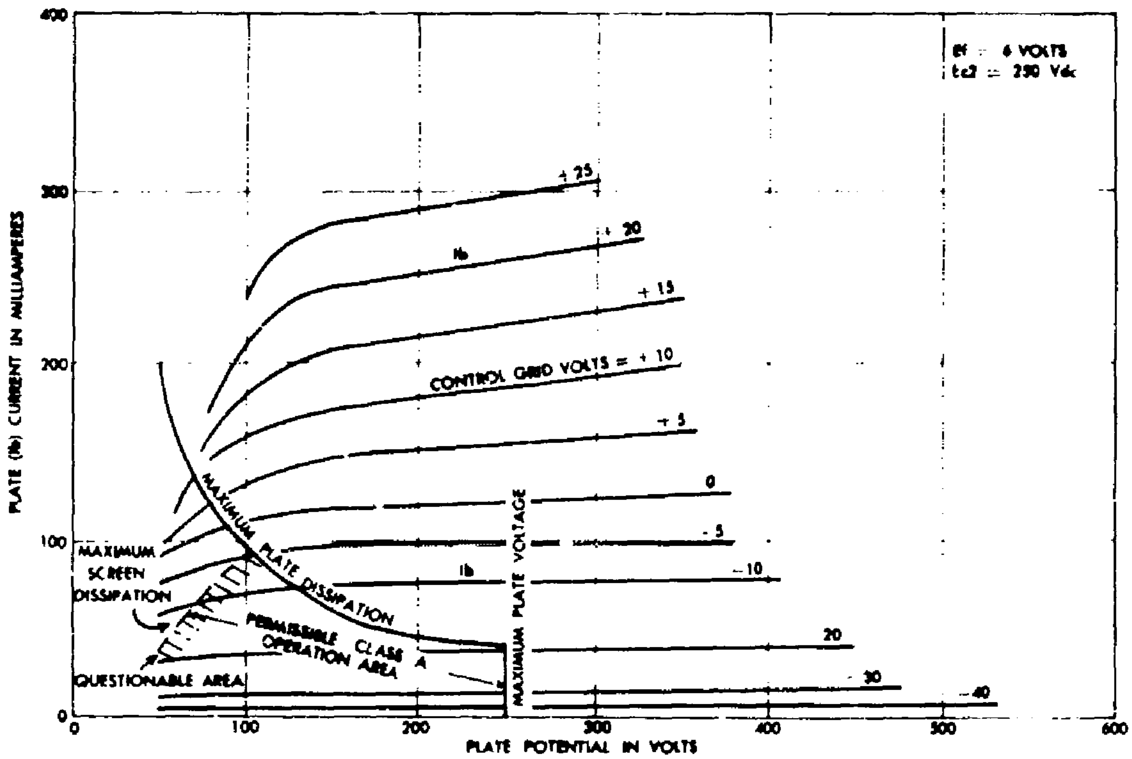


Figure 3-53. Typical Static Plate Characteristics of the Tube Type JAN-2E30; Permissible Area of Operation.

3.12.14 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this manual.

TABLE 3-15. APPLICATION PRECAUTIONS FOR JAN-2E30

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation, 1.3.20, 3.2.16
Screen Grid:
Supply. 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Temperature

Bulb and Environmental, 3.2.4

Current

Control Grid, 1.3.4, 1.3.1, 1.3.23, 3.2.9
Screen Grid, 3.2.3

Current (Cont.)

Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.12.15 VARIABILITY OF CHARACTERISTICS.

3.12.16 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.12.17 The chart below presents the limit behavior of static plate characteristics for JAN-2E30 as defined by MIL-E-1/32 dated 3 February 1953.

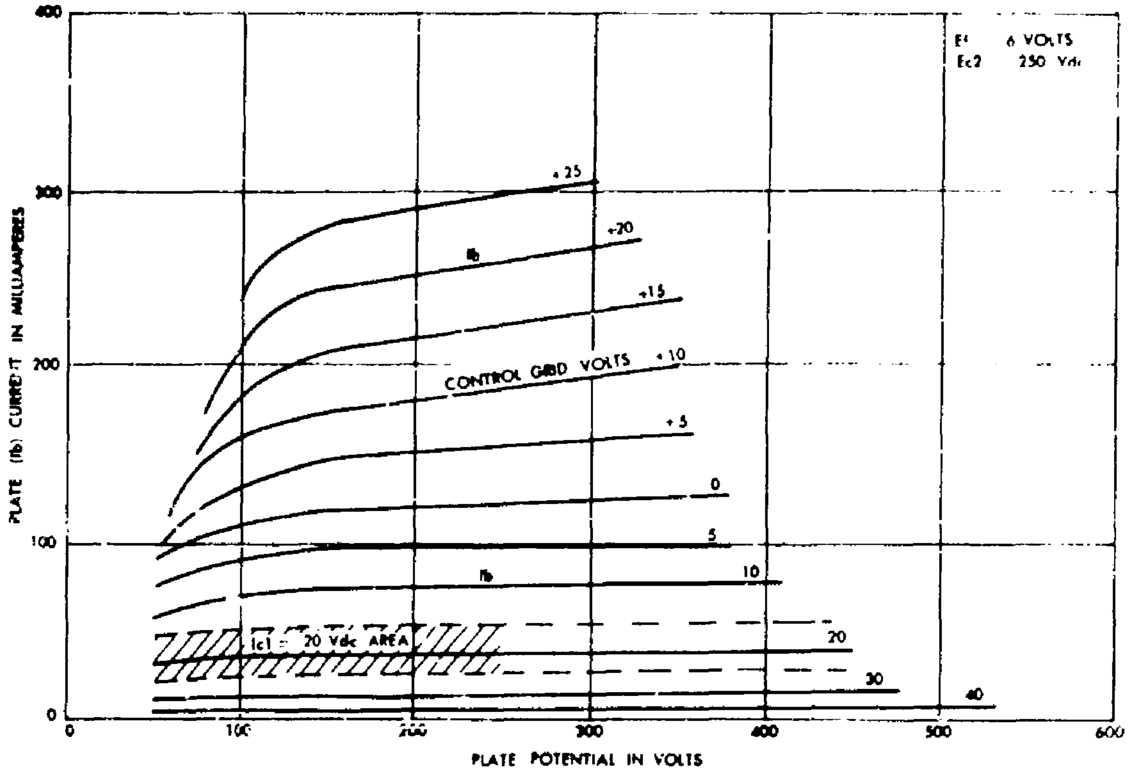


Figure 3-54. Limit Plate Characteristic of JAN-2E30

3.12.18 The chart below presents the limit behavior of transfer data for JAN-2E30 as defined by MIL-E-1/32 dated 3 February 1953.

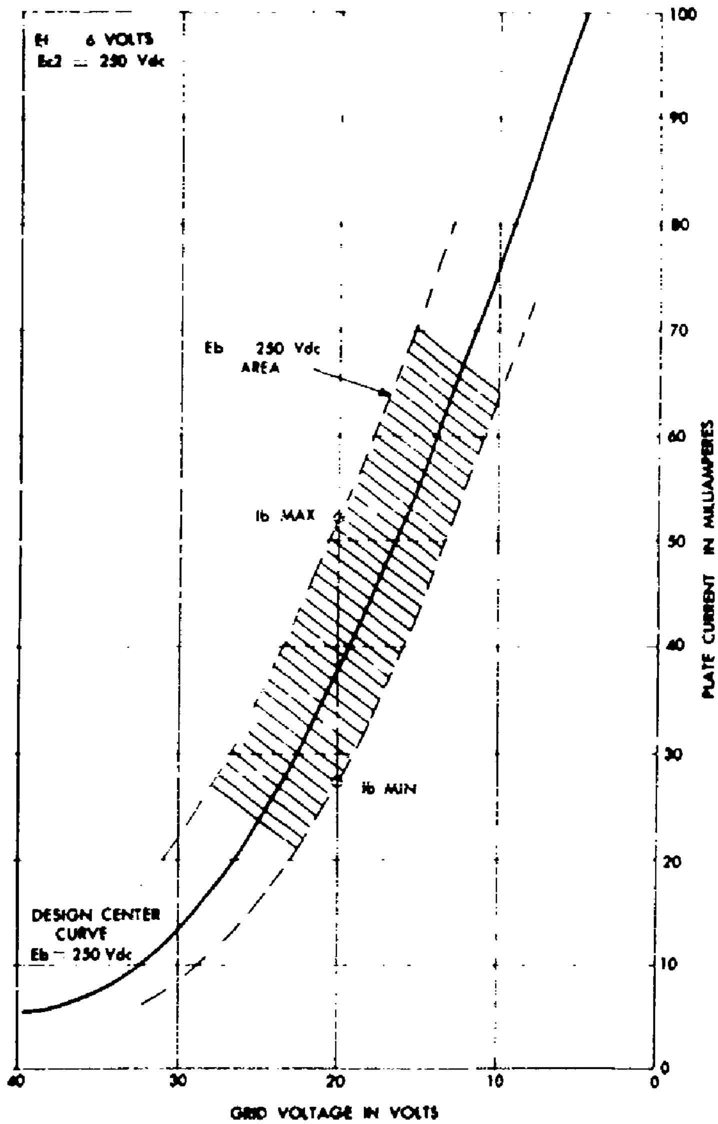


Figure 3-55. Limit Transfer Characteristics of Tube Type JAN-2E30

3.12.19 DESIGN CENTER CHARACTERISTICS.

3-12.20 These typical curves have been obtained from current data being published by the original RETMA registrant of this type. The charts below present the Static Plate Characteristics of JAN-2E30.

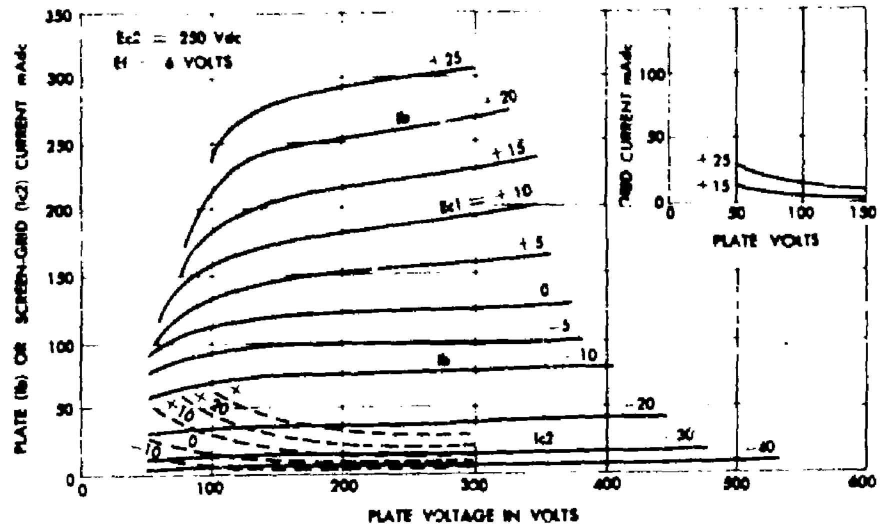


Figure 3-56. Typical Static Plate Characteristics of Tube Type JAN-2E30
Ec2 = 250

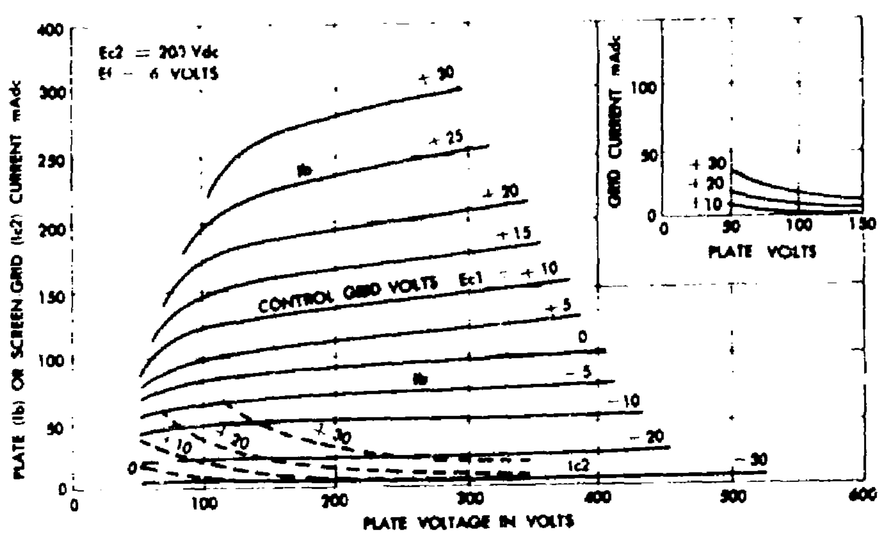


Figure 3-57. Typical Static Plate Characteristics of Tube Type JAN-2E30
Ec2 = 200

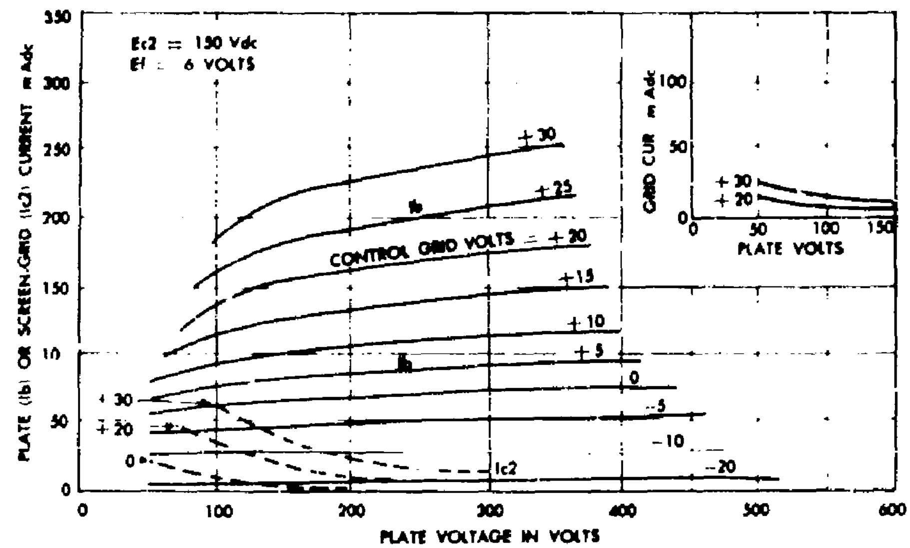


Figure 3-58. Typical Static Plate Characteristics of Tube Type JAN-2E30; Ec2 = 150

SECTION 13

TUBE TYPE JAN-3A5

3.13 DESCRIPTION.

3.13.1 The JAN-3A5 1/ is a miniature, filamentary twin triode designed for use as a high-frequency amplifier or oscillator in portable, battery-operated equipment. Operation at a filament voltage of either 2.8 volts or 1.4 volts is permitted by the center-tapped filament.

3.13.2 ELECTRICAL. The electrical characteristics are as follows:

Filament Voltage	Series 2.8 Vdc
	Parallel 1.4 Vdc
Cathode	Coated Filament

3.13.3 MOUNTING. Not specified.

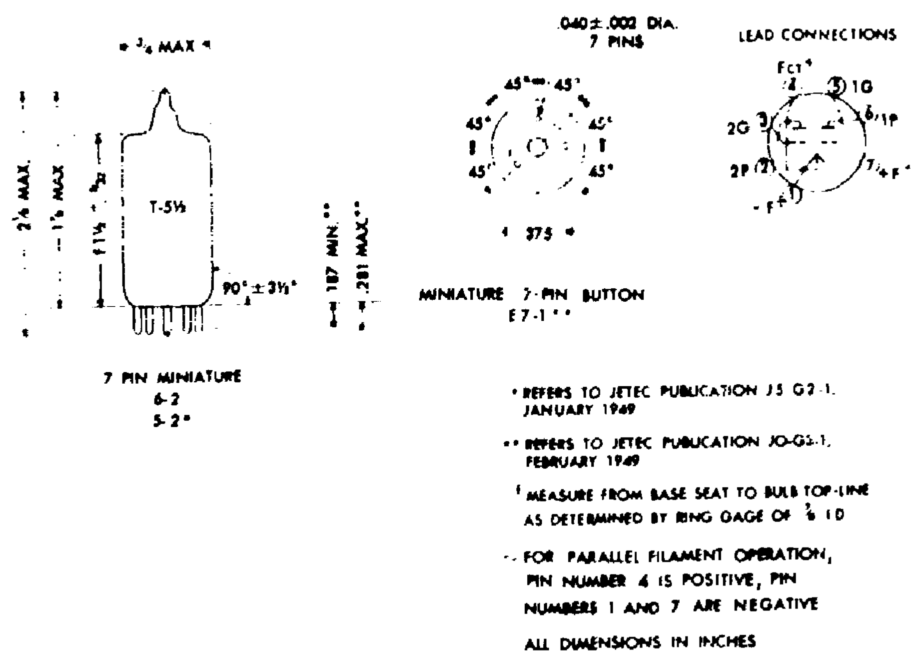


Figure 3-59. Outline Drawing and Base Diagram of Tube Type JAN-3A5

1/ The values and specification comments presented in this section are related to MIL-E-1/33A dated 14 January 1954.

3.13.4 RATINGS, ABSOLUTE SYSTEM.

3.13.5 The absolute system ratings are as follows:

Filament Voltage	1.4 ± 15% or 2.8 ± 15% Vdc
Plate Voltage	150 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Cathode Current (per Cathode)	14 mAdc
Plate Dissipation (per plate)	1.0 W
Altitude Rating	10,000 ft

3.13.6 TEST CONDITIONS.

3.13.7 Test conditions are as follows:

Filament Voltage, Ef	1.4 Vdc
Plate Voltage, Eb	135 Vdc
Grid Voltage, Ec	-1.5 Vdc

3.13.8 ACCEPTANCE TEST LIMITS.

3.13.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/33A dated 14 January 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-16. ACCEPTANCE TEST LIMITS OF JAN-3A5

PROPERTY		MEASUREMENT CONDITION	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Filament Current	If		200	240	---	---	mA
Transconductance	Sm		2080	3120	1690	---	umhos
Amplification Factor	Mu		13	17	---	---	-----
Plate Current (1)	Ib		8.3	16.7	---	---	mAdc
Plate Current (2)	Ib	Ec = -10.5 Vdc Eb = 90 Vdc Test Each unit separately; unit not under test, Ec = -50 Vdc	---	375	---	---	uAdc
Power Oscillation (1)	Po	F = 50 mc Push-pull Ib = 30 mAdc Ic = 6 mAdc Rg = 4000 ohms	0.45	---	---	---	W
Power Oscillation (2)	Po	Ef = 1.1	0.45	---	---	---	.
Capacitance (Unshielded)	Cgp	Ef = 0	2.7	3.7	---	---	uuf
	Cin	Ef = 0	0.70	1.10	---	---	uuf
	Cout	Ef = 0	0.70	1.30	---	---	uuf
Grid Current	Ic	Units tied together	0	-1.5	---	---	uAdc

3.13.10 APPLICATION.

3.13.11 The chart below shows the permissible operating area for JAN-3A5 as defined by the ratings in MIL-E-1/33A dated 14 JAN 1954. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2 through 3.1.6.

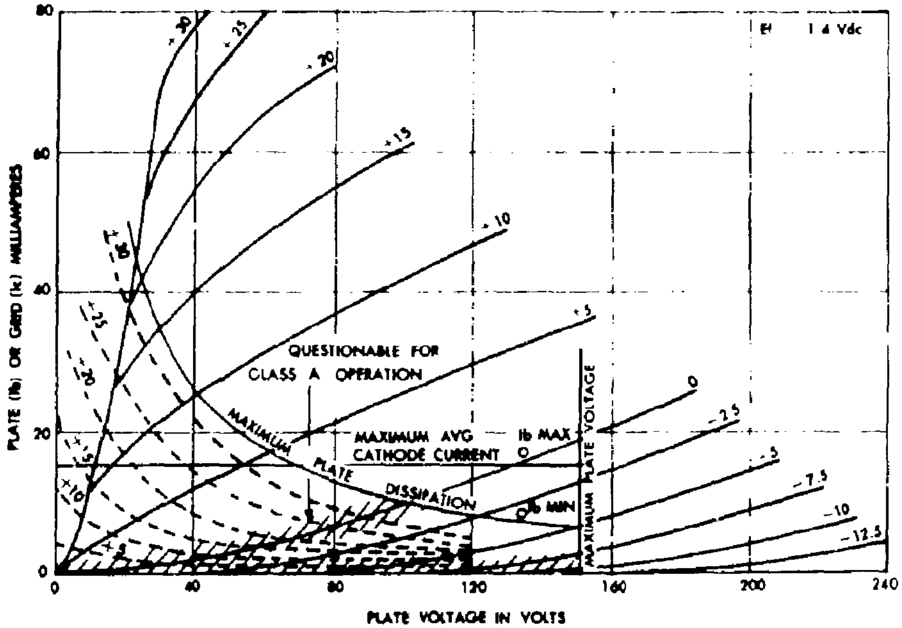


Figure 3-60. Typical Static Plate Characteristics of Tube Type JAN-3A5; Permissible Area of Operation

3.13.12 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this manual.

TABLE 3-17. APPLICATION PRECAUTIONS FOR JAN-3A5

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Plate:
- High, 3.1.8
- Low, 3.1.15
- AC Operation, 1.3.20, 3.1.10
- 28 Volt, 3.1.15

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.1.3
- Cathode, 2.1.3, 3.1.12

Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode, 2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14

Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.13.13 VARIABILITY OF CHARACTERISTICS.

3.13.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.13.15 The chart below presents the limit behavior of static plate characteristics for JAN-3A5 as defined by MIL-E-1/33A dated 14 January 1954.

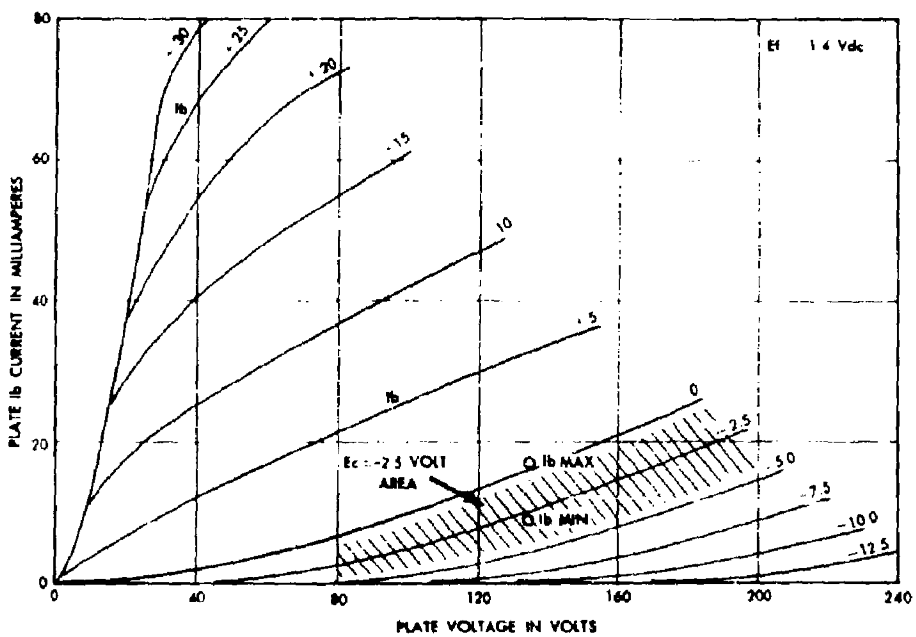


Figure 3-61. Limit Plate Characteristics of JAN-3A5

3.13.16 DESIGN CENTER CHARACTERISTICS.

3.13.17 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.13.18 The chart below presents the Static Plate Characteristics of JAN-3A5.

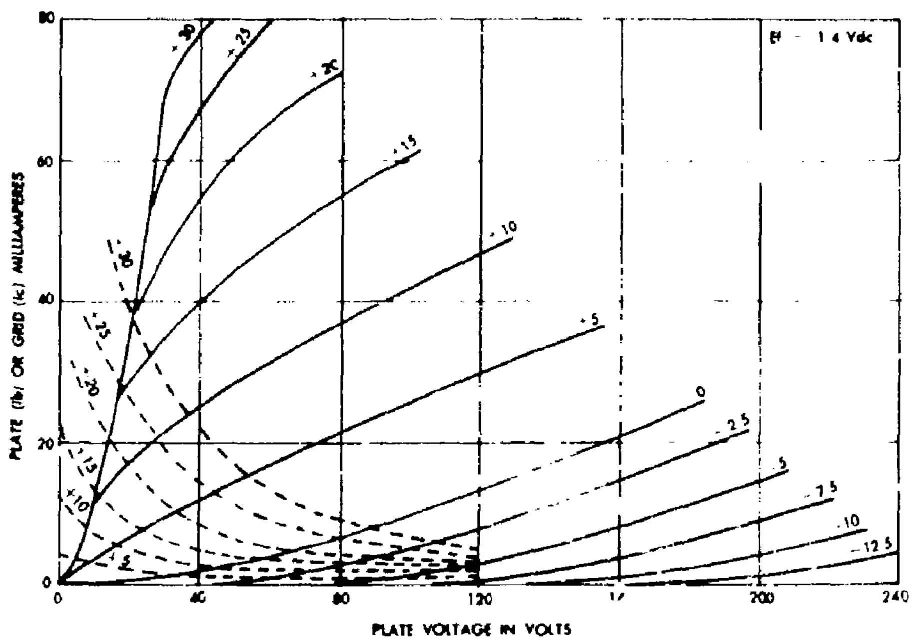


Figure 3-62. Typical Static Plate Characteristics of JAN-3A5

SECTION 14

TUBE TYPE JAN-3B4

3.14 DESCRIPTION.

3.14.1 The JAN-3B4 1/ is a 7 pin, miniature, filamentary, beam power amplifier.

3.14.2 ELECTRICAL. The electrical characteristics are as follows:

	Parallel	Series
Filament Voltage	1.25V	2.5 V
Cathode	Oxide Coated Filament	

3.14.3 MOUNTING. Any type of mounting is adequate.

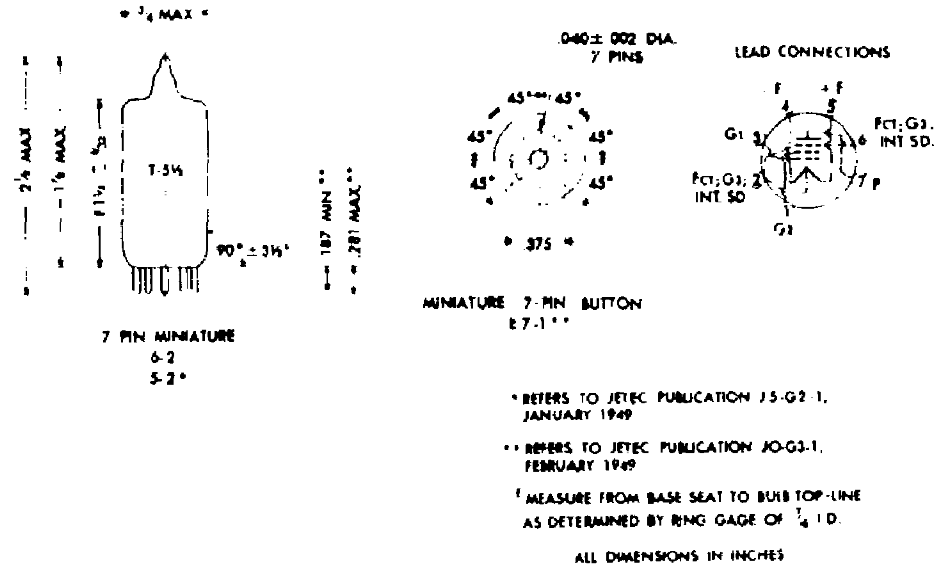


Figure 3-63. Outline Drawing and Base Diagram of Tube Type JAN-3B4

3.14.4 RATINGS, ABSOLUTE SYSTEM.

3.14.5 The absolute system ratings are as follows:

	Parallel	Series
* Filament Voltage, Maximum	1.438V	2.875V
* Filament Voltage, Minimum	1.062V	2.125V
Plate Voltage, Maximum	150 Vdc	

* No test of operation at this rating exists in the specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/34B dated 17 December 1954.

	Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
*	Control Grid Voltage, Minimum	-75 Vdc
*	Control Grid Current	1.5 mAdc
*	Plate Dissipation	3 W
*	Screen Grid Dissipation	1.1 W
*	Plate Current	25 mAdc
	Screen Grid Voltage	135 Vdc
*	Altitude Rating	10,000 ft
	Frequency Rating	100 Mc

3.14.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.14.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	2.5 Vac
Plate Voltage, Eb	200 Vdc
Control Grid Voltage, Ec1	-25 Vdc
Screen Grid Voltage, Ec2	150 Vdc

3.14.8 ACCEPTANCE TEST LIMITS.

3.14.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/34B dated 17 December 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test of operation at this rating exists in the specification.

TABLE 3-18 ACCEPTANCE TEST LIMITS OF JAN-3B4

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Filament Current	If	Ef = 2.5 V	150	180	---	---	mA
Grid Current	Ic1	Measuring time, t = 120 Sec.	0	-1.5	---	---	uAdc
Screen Grid Current	Ic2		---	2	---	---	mAdc
Plate Current	Ib		13	26	---	---	mAdc
Transconductance	Sm		1400	2300	---	---	umhos
Triode Amplification Factor	Mu	Eb = Ec2 = 150 Vdc	2.7	4.7			
Primary Screen Emission		Eb = 0; Ec2 = 127 Vdc; Ec1/ Pg2 = 1W measuring time, t= 300 sec.	---	200			uAdc
Operation peak output voltage	ep	Ebh = 150 Vdc Ec1 = 0; Ec2 = 135 Vdc; Rl= 1000; Eg1 = 50 Vac; Rg1= 55,000	100	---	85	---	v
Operation Screen Grid Current	Ic2	Ebb = 150 Vdc Ec1 = 0; Ec2= 135 Vdc; Rl= 1000; Eg1 = 50 Vac Rg1 = 55,000	5.5	11	---	15	mAdc
Activity	$\Delta \frac{Ep}{Ef}$	Ef = 2.125 Vac	---	7.5	---	15	%
Class C Amplifier		F = 100 mc Eb = Ec2 = 90 Vdc, Rg1 = 45,000 Excitation, eg = 35 v peak; Max Po/Ib = 15 mAdc	0.5	---			W

3.14.10 The following table lists general considerations for the application of this type. The numbers refer to the applicable section or paragraph of this manual.

TABLE 3-19. APPLICATION PRECAUTIONS OF JAN-3B4

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation, 1.3.20, 3.2.18
Screen Grid:
Supply, 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19

Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.14.11 VARIABILITY OF CHARACTERISTICS.

3.14.12 The published technical data which describe and define electron tubes, in general, present only average or center values. Consequently the variation inherent in a typical characteristic curve is frequently overlooked. The designer is directed to the specification of this type wherein the variation of tube properties are defined by a series of operation tests. The class A variability of this type is difficult to portray, inasmuch as most of the acceptance testing of this type utilize its properties as an oscillator or class C amplifier.

3.14.13 DESIGN CENTER CHARACTERISTICS.

3.14.14 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.14.15 The charts below represent the typical static plate behavior of JAN-3B4.

3.14.16 APPLICATION OF JAN-3B4.

3.14.17 The chart below shows the permissible operation area for JAN-3B4 as defined by the ratings in MIL-E-1/34B dated 17 December 1954. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7 of this manual.

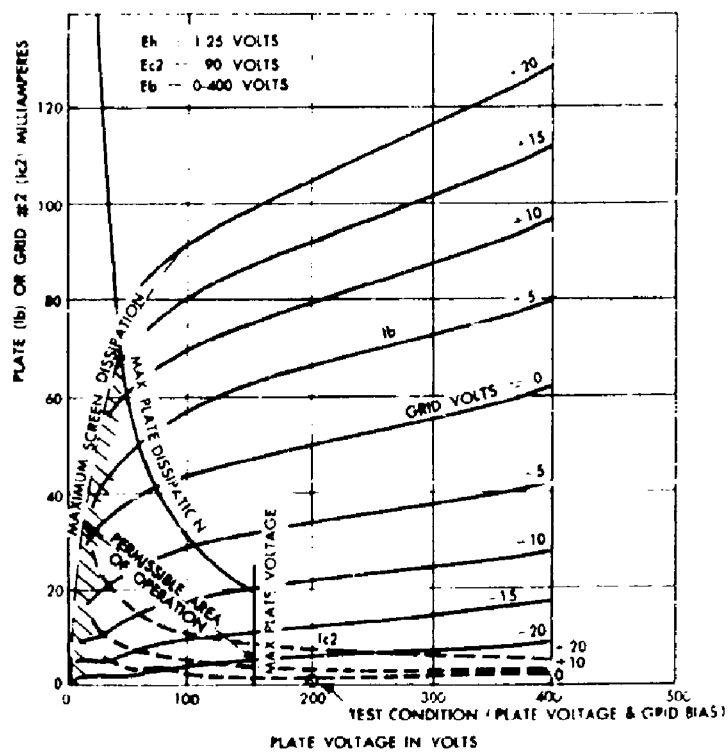


Figure 3-64. Typical Static Plate Characteristics of Tube Type JAN-3B4; Permissible Area of Operation

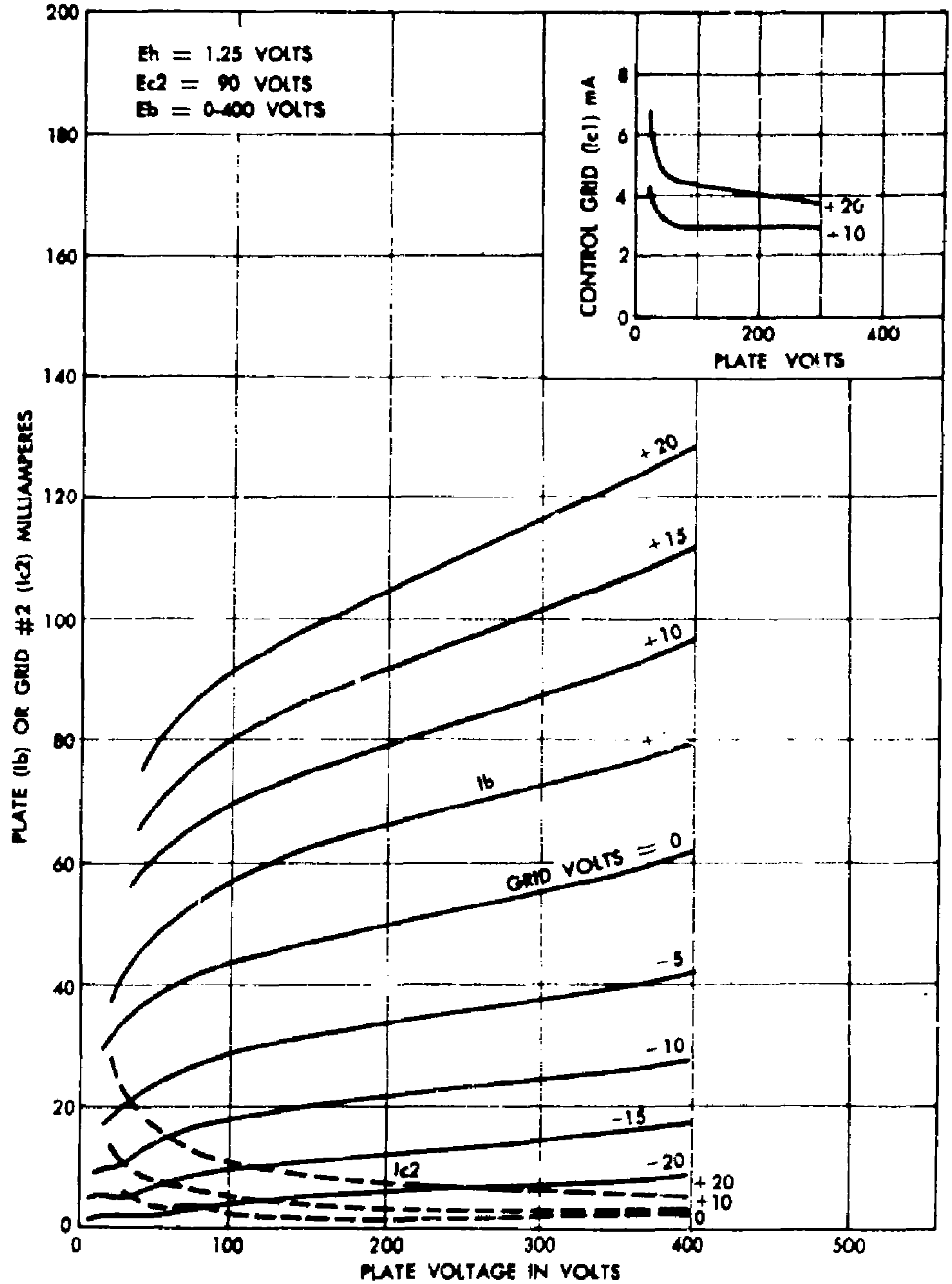


Figure 3-65. Typical Static Plate Characteristics of JAN-3B4; Ec2 = 90

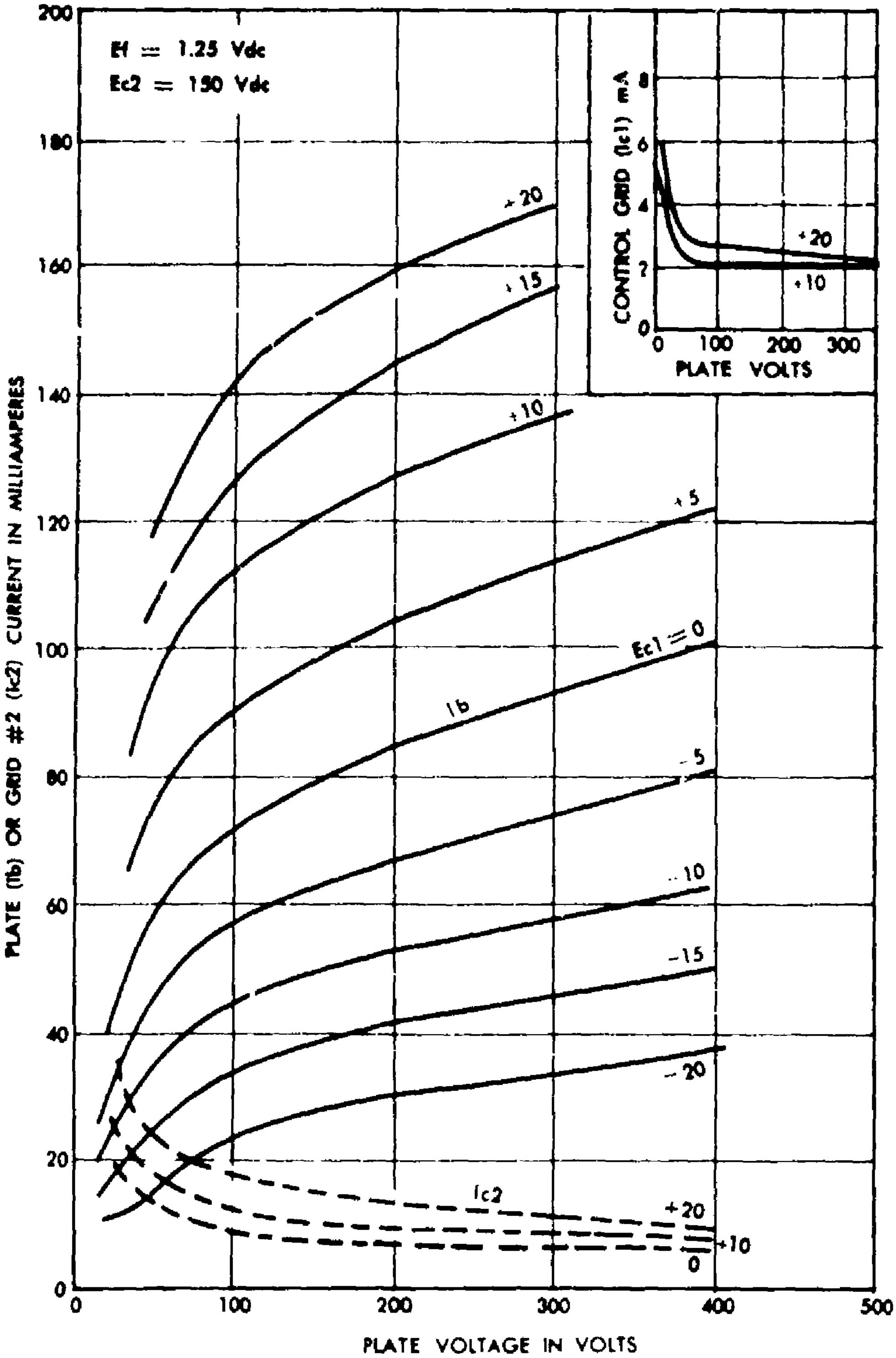


Figure 3-66. Typical Static Plate Characteristics of JAN-3B4; Ec2 = 150

SECTION 15

TUBE TYPE JAN-3V4

3.15 DESCRIPTION.

3.15.1 The JAN-3V4 1/ is a 7pin miniature, filamentary pentode, power, amplifier.

3.15.2 ELECTRICAL. The electrical characteristics are as follows:

	Parallel	Series
Filament Voltage	1.4	2.8
Filament Current	88-112mADC	44-56 mAdc
Cathode	Coated filament	

3.15.3 MOUNTING. Not specified.

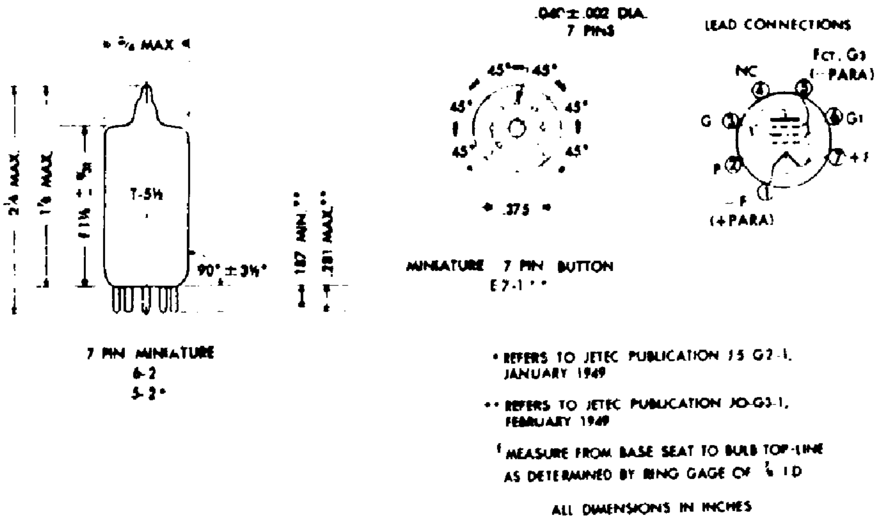


Figure 3-67. Outline Drawing and Base Diagram of Tube Type JAN-3V4

3.15.4 RATINGS, ABSOLUTE SYSTEM.

3.15.5 The absolute system ratings are as follows:

Filament Voltage	1.4 or 2.8 ± 15%
Plate Voltage	100Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Screen Voltage	100 Vdc
Cathode Current.	13 mAdc
Altitude Rating	10,000 ft

1/ The values and specification comments presented in this section are related to MIL-E-1/171 dated 20 May 1953.

3.15.6 TEST CONDITIONS.

3.15.7 Test conditions are as follows:

Filament Voltage, Ef . . . . 1.4 Vdc
Plate Voltage, Eb . . . . 90 Vdc
Control Grid Voltage, Ecl . . . . -4.5 Vdc
Screen Grid Voltage, Ec2 . . . . 90 Vdc

3.15.8 ACCEPTANCE TEST LIMITS.

3.15.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/343 dated 14 August 1953 should be referenced to determine further assurance of Satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-20. ACCEPTANCE TEST LIMITS OF JAN-3V4

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Filament Current	If		88	112	---	---	mA
Grid Current	Icl		0	-1.0	---	---	uAdc
Plate Current	Ib		6.5	12.5	---	---	mAdc
Screen Current	Ic2		1.3	3.1	---	---	mAdc
Transconductance	Sm		1800	2500	---	---	umhos
Power Output (1)	Po	Esig = 3.2 Vac Rp = 0.01 Meg	210	---	135	---	mW
Power Output (2)	Po	Esig = 3.2 Vac Rp = 0.01 Meg Ef = 1.1 Vdc	140	---	---	---	mW
Capacitance (Unshielded)	Cgl-p	Ef = 0	---	0.40	---	---	uuf
	Cin	Ef = 0	3.8	7.3	---	---	uuf
	Cout	Ef = 0	2.2	5.4	---	---	uuf

3.15.10 APPLICATION OF JAN-3V4.

3.15.11 The chart below shows the permissible operating area for JAN-3V4 as defined by the ratings in MIL-E-1/171, dated 20 May 1953. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

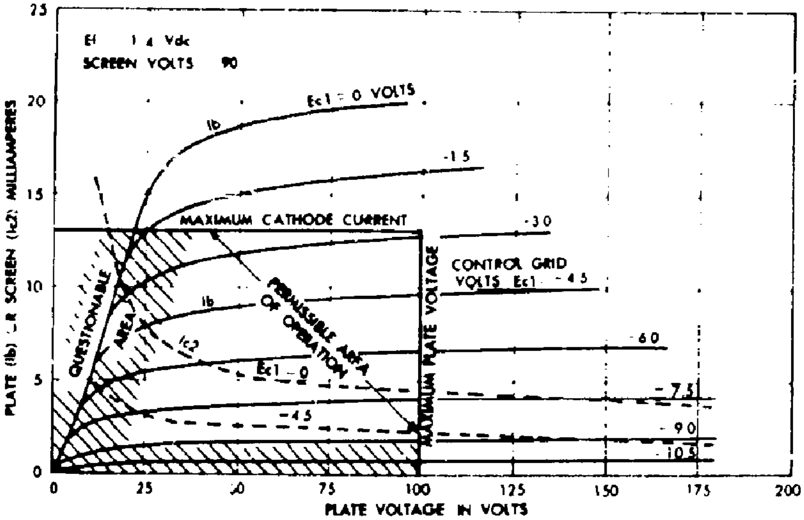


Figure 3-68. Typical Static Plate Characteristics of Tube Type JAN-3V4; Permissible Area of Operation

3.15.12 The following table lists general considerations for the application of this tube type. The numbers refer to applicable sections or paragraphs of this manual.

TABLE 3-21. APPLICATION PRECAUTIONS FOR JAN-3V4

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation, 1.3.20, 3.2.18
Screen Grid:
Supply, 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.15.13 VARIABILITY OF CHARACTERISTICS.

3.15.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.15.15 The chart below presents the limit behavior of static plate characteristics for JAN-3V4 as defined by MIL-E-1/171, dated 20 May 1953.

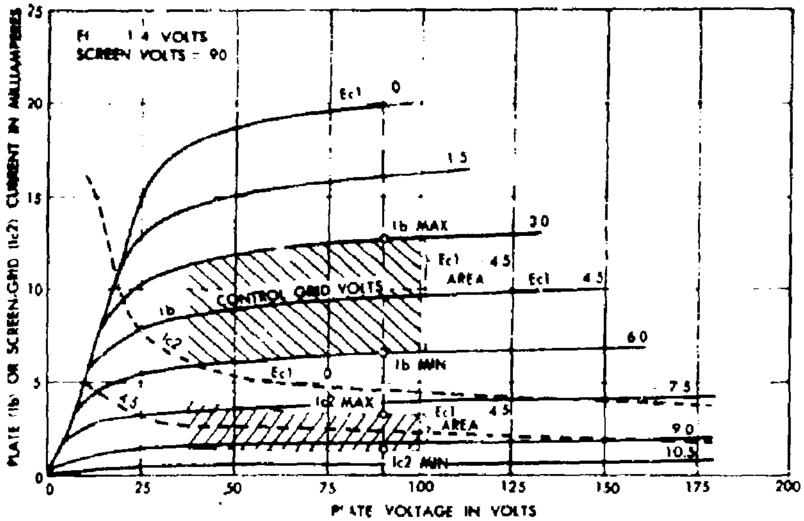


Figure 3-69. Limit Plate Characteristics of JAN-3V4

3.15.16 DESIGN CENTER CHARACTERISTICS.

3.15.17 These typical curves have been obtained from current data being published by the original RETMA registrant of this tube type.

3.15.18 The chart below represents the Static Plate Characteristics of JAN-3V4.

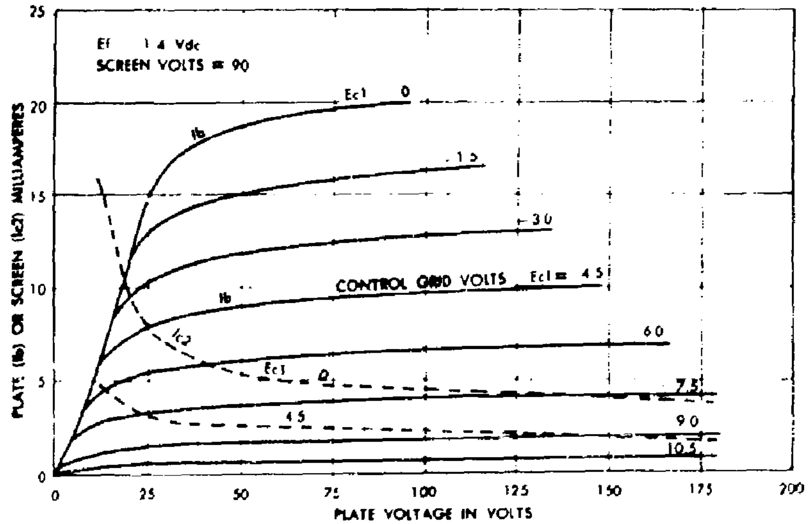


Figure 3-70. Typical Static Plate Characteristics of JAN-3V4

TUBE TYPE JAN-5R4WGA

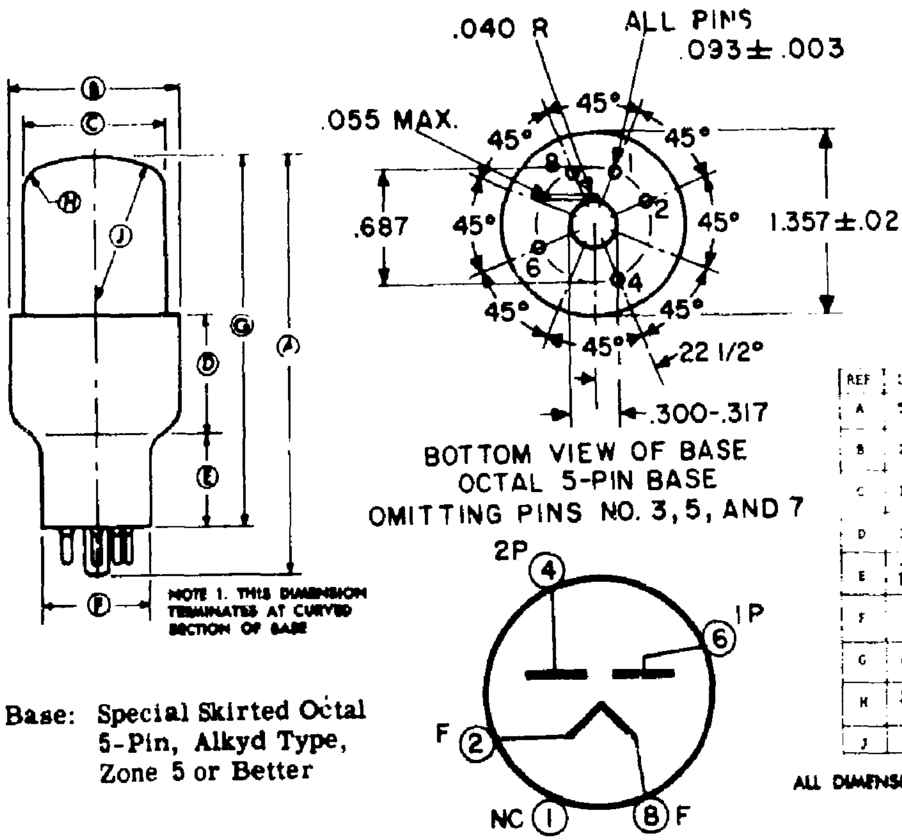
3.16 DESCRIPTION.

3.16.1 The JAN-5R4WGA 1/ is a 5-pin, octal-base, full-wave, high vacuum rectifier suitable in applications where the d-c load current does not exceed .275 milliamperes.

3.16.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 5.0 Vac
Cathode. . . . . Coated Filament

3.16.3 MOUNTING. Mounting is vertical or as specified.



Base: Special Skirted Octal 5-Pin, Alkyd Type, Zone 5 or Better

REF	DIMENSION
A	5 [illegible]/16 MAX
B	[illegible]/16 MAX
C	1 3/4 ± [illegible]
D	1 [illegible] MAX
E	7/8 MIN SEE NOTE 1
F	1.337 MIN 1.377 MAX
G	[illegible] MAX
H	[illegible]/16 O.R. NOM
J	2 O.R. NOM

ALL DIMENSIONS IN INCHES

Figure 3-71. Outline Drawing and Base Diagram of Tube Type JAN-5R4WGA

1/ The values and specification comments presented in this section are related to MIL-E-1/116A dated 4 March 1954.

3.16.4 RATINGS, ABSOLUTE MAXIMUM.

3.16.5 The absolute maximum ratings are as follows:

Heater Voltage . . . . 5 Vac ± 10%
* Peak Inverse Plate Voltage . . . . 3050 v
Steady State Peak Plate Current (per Plate) . . . 700 Ma
Output Current . . . . 275 mAdc
Cathode Conditioning Time . . . . 10 Sec
Altitude Rating (See Chart)

3.16.6 TEST CONDITIONS.

3.16.7 Test Conditions are as follows:

Heater Voltage, Ef . . . . 5.0 Vac
Plate Supply Voltage (per Plate) Epp/p . . . . . . 850 Vac
Load Resistance, RL . . . . 3500 ohms
Load Capacitance, CL . . . . 4 uf
Plate Circuit Impedance (per Plate) Max Zp/p 200 ohms

3.16.8 ACCEPTANCE TEST LIMITS.

3.16.9 The following table summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/116A dated 4 March 1954 should be referenced to determine further assurance of satisfactory operation in any specific

TABLE 3-22. ACCEPTANCE TEST LIMITS OF JAN-5R4WGA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				
			INITIAL		LIFE TEST		UNITS
			MIN	MAX	MIN	MAX	
Heater Current	If		1.8	2.2	---	---	A
Operation (1)	Io	epx = 2800 v Full-wave Zp/p = 500 RL = 7000 ohms tk = 10	140	---	---	---	mAdc
Operation (2)	Io	Full-Wave tk = 10	245	---	210	---	mAdc
Emission (Each plate separately)	Is	Eb = 75 Vdc	225	400	---	---	mAdc

* No test at this rating exists in the specification.

application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

3.16.10 APPLICATION.

3.16.11 RATING CHARTS.

3.16.12 Rating Charts I, II and III represent areas of permissible operation within which any application of the JAN-5R4WGA must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.16.13 RATING CHART I. Rating Chart I (Figure 3-72) is based on maximum rated peak inverse voltage per plate (epx) of 3050 volts and maximum rated d-c output current per plate (Io/p) of 137.5 milliamperes. Point C corresponds to the simultaneous occurrence of these two ratings, permissible only under choke-input filter conditions. Point E is derived from life test conditions of rated d-c output current into capacitor input filter. The area CDE is restricted to choke input service only.

3.16.14 RATING CHART II. Rating Chart II (Figure 3-73), for capacitor input filter applications, is based on maximum rated d-c output current per plate (Io/p) and maximum rated steady state peak plate current (Ib) of 700 milliamperes per plate. Rectification efficiency must not exceed 0.54 under conditions of maximum rated d-c output current.

3.16.15 RATING CHART III. Rating Chart III (Figure 3-74), for capacitor input filter applications, is based on maximum rated surge current (i surge) of 2.2 amps per plate. Minimum permissible series resistance (Rs) is approximately 575 ohms per plate under conditions of maximum permissible supply voltage.

3.16.16 RATING CHART IV. (Figure 3-75), sets forth limiting conditions under high altitude operation, in terms of permissible peak-inverse plate voltage. Maximum peak inverse voltage rating of 3050 volts must be decreased at altitude greater than 30,000 feet, as shown on the chart.

3.16.17 RATING CHART V. Rating Chart V (Figure 3-76), for capacitor input filter applications, is based on maximum rated surge current (i surge) of 2.2 amperes per plate. Minimum permissible series resistance (Rs) is approximately 575 ohms per plate under conditions of maximum permissible supply voltage.

3.16.18 OTHER CONSIDERATIONS.

3.16.19 HEATER VOLTAGE. For a discussion of heater voltage considerations, see paragraph 3.3.9.

3.16.20 TYPICAL CHARACTERISTICS.

3.16.21 Fig. 3-77 presents the static plate characteristic of the JAN-5R4WGA, reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification which provides only a minimum limit on emission.

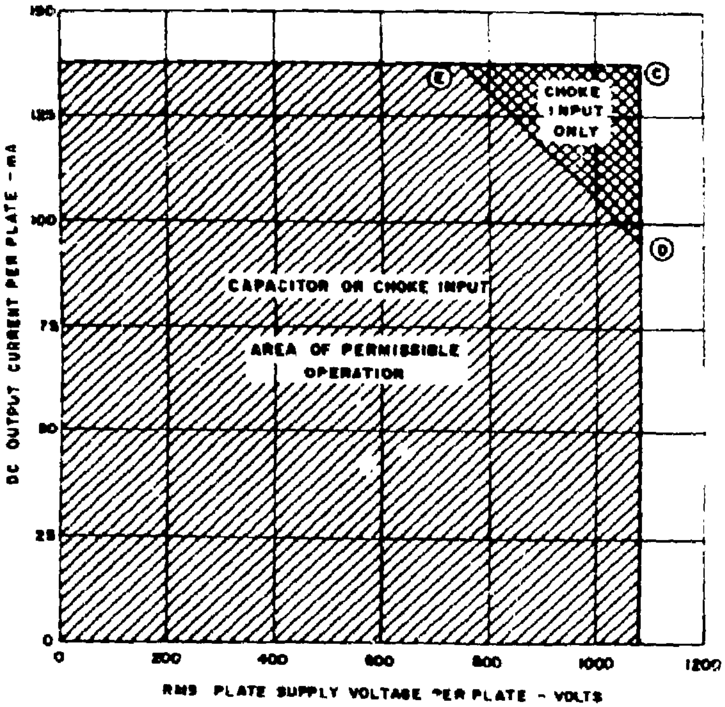


Figure 3-72. Rating Chart I for Tube Type JAN-5R4WGA Showing Permissible Operating Area for Choke and Capacitor Input Circuits

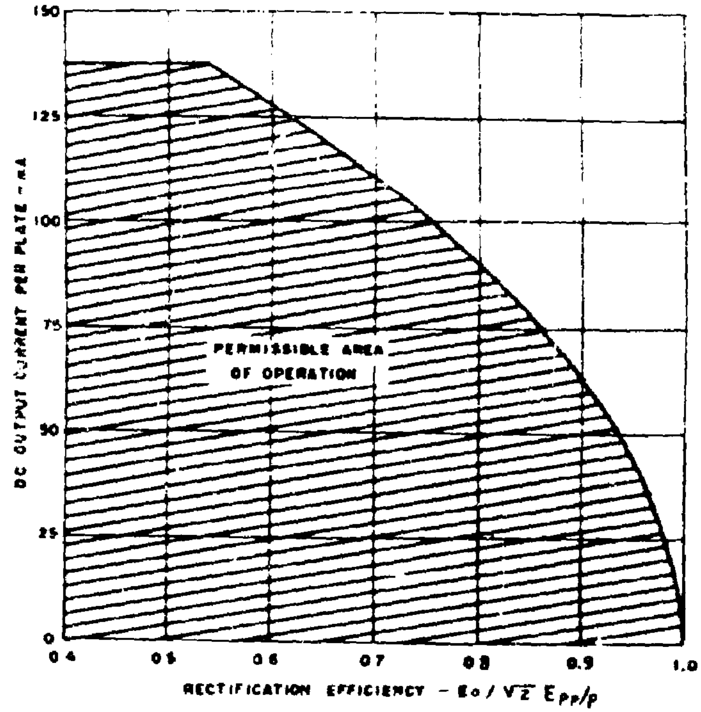


Figure 3-73. Rating Chart II for Tube Type JAN-5R4WGA Showing Permissible Operating Area for Capacitor Input Filter Operation

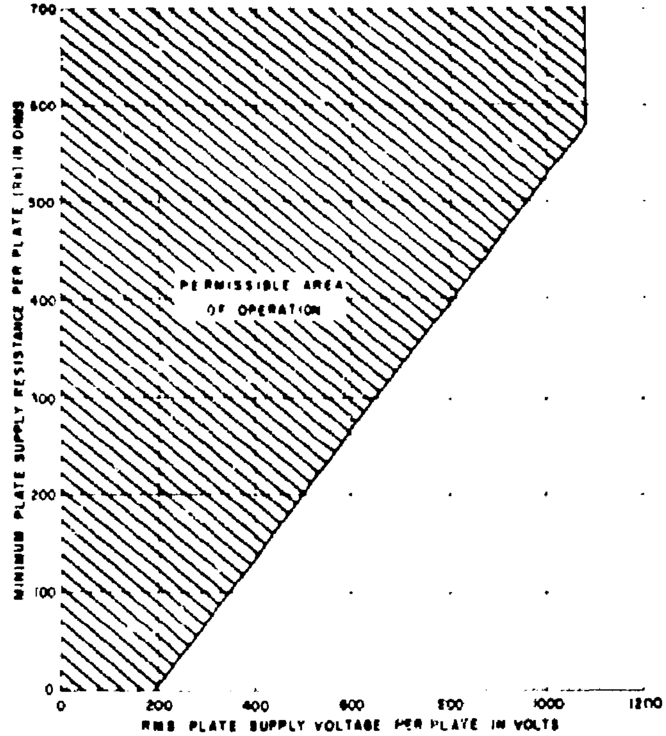


Figure 3-74. **Rating Chart III for Tube Type JAN-5R4WGA Showing Minimum Allowable Resistance Effectively in Series with Each Plate of Rectifier Tube for any Allowable A-C Plate Voltage**

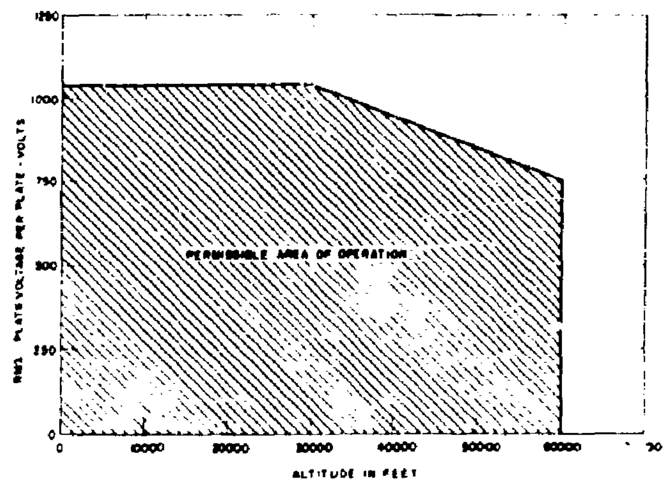


Figure 3-75. **Rating Chart IV for Tube Type JAN-5R4WGA Altitude Rating**

Satisfactory operation of this Tube Under Conditions falling within AREA 1 may be obtained without filament preheating. Filament preheating for 10 seconds before plate voltage is applied is recommended for satisfactory operation under conditions falling within AREA 2.

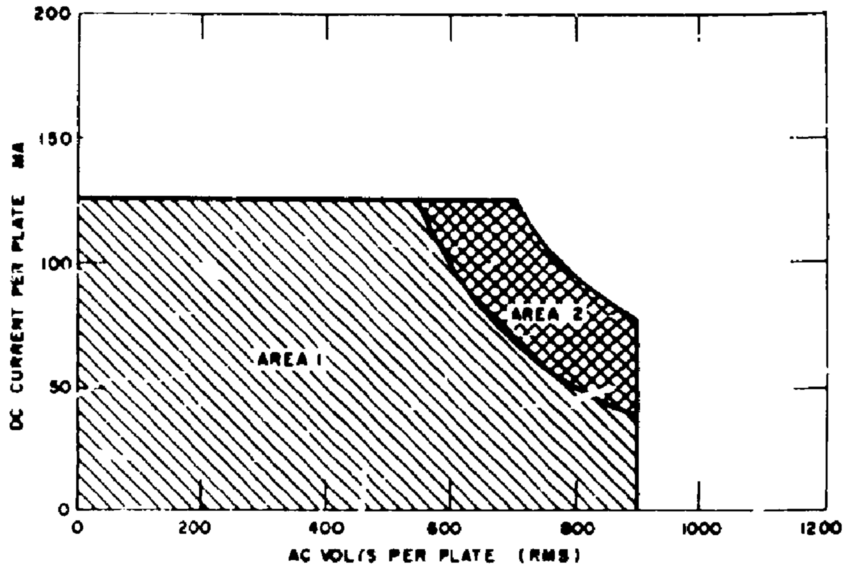


Figure 3-76. Rating Chart V for Tube Type JAN-5R4WGA Showing Cathode Conditioning Time (Design Center Rating)

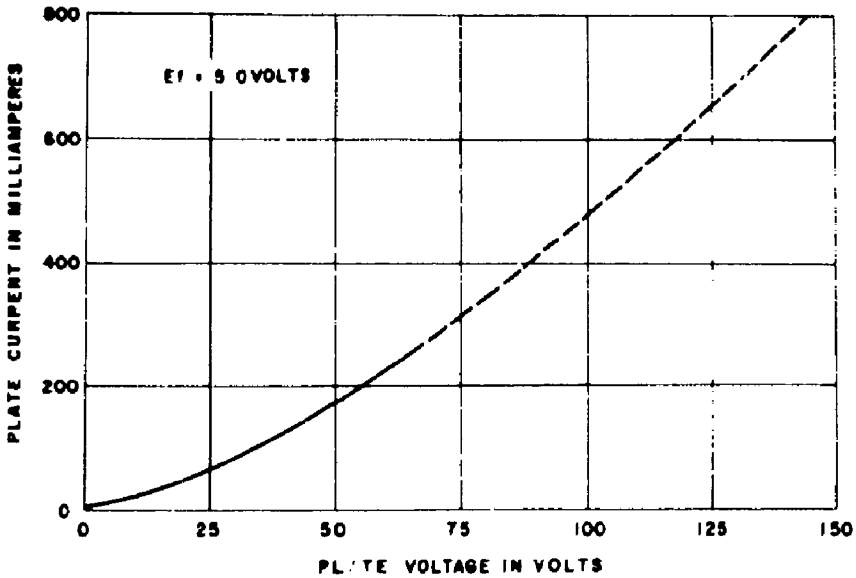


Figure 3-77. Typical Plate Characteristics for Tube Type JAN-5R4WGA

TUBE TYPE JAN-5Y3WGTA

3.17 DESCRIPTION.

3.17.1 The JAN-5Y3WGTA 1/ is a 5-pin, octal-base, full wave, high-vacuum rectifier suitable for operation where the average d-c current does not exceed 140 milliamperes.

3.17.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	5.0 V
Cathode	Coated Filament

3.17.3 MOUNTING. Not specified.

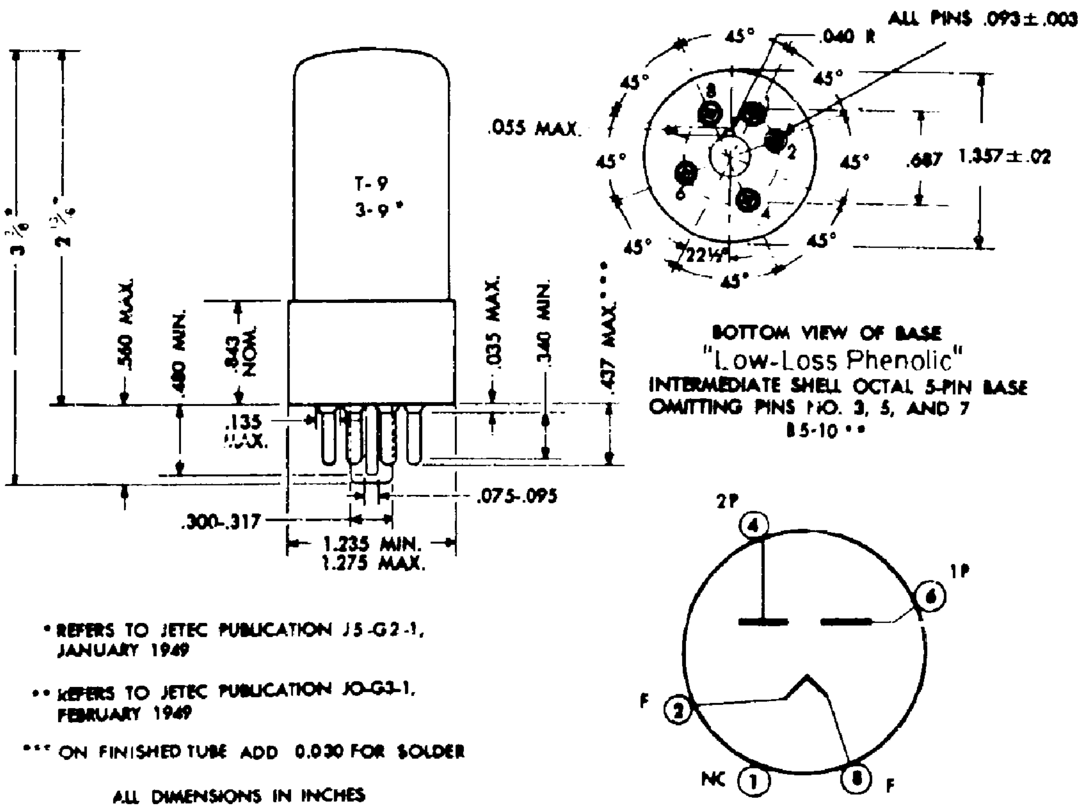


Figure 3-78. Outline Drawing and Base Diagram of Tube Type JAN-5Y3WGTA

1/ The values and specification comments presented in this section are related to MIL-E-1/44A dated 14 January 1954.

3.17.4 RATINGS, ABSOLUTE SYSTEM.

3.17.5 The absolute maximum ratings are as follows:

Heater Voltage . . . . 5.0 Vac ± 10%
Peak Inverse Plate Voltage (see Chart I) . . . . . . 1550 v
Steady State Peak Plate Current (Chart II) . . . . 415 Ma
Output Current (both sections) . . . . 140 mA
* Transient Peak Plate Current (Chart III) . . . . 1.4 a
Bulb Temperature . . . . 180^0 C
Altitude Rating . . . . 50,000 ft

3.17.6 TEST CONDITIONS.

3.17.7 Test conditions are as follows:

Heater Voltage, Ef . . . . 5.0 Vac
Plate Supply Voltage, Epp . . . . 400 Vac
Load Resistance (Unity Power Factor) . . . . 2750 ohms
Load Capacitance . . . . 4 uf

3.17.8 ACCEPTANCE TEST LIMITS.

3.17.9 The following table summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/144A dated 14 January 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

TABLE 3-23. ACCEPTANCE TEST LIMITS OF JAN-5Y3WGTA

PROPERTY	MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIMITS LIFE TEST MIN	LIMITS LIFE TEST MAX	UNITS
Filament Current If		1.6	2.0	---	---	A
Operation Io	See Note	125	---	110	---	mAdc
Emission Section 1 Is	E2b = 0 E1b = 75 Vdc	120	---	---	---	mAdc
Section 2 Is	E1b = 0 E2b = 75 Vdc	120	---	---	---	mAdc

Note: In a full wave circuit, adjust Zp/p such that a tube having Etd 60 Vdc at 125 mAdc per plate gives Io = 140 mAdc.

* No measurement test at this rating exists in the specification.

3.17.10 APPLICATION.

3.17.11 RATING CHARTS.

3.17.12 Rating Charts I, II and III represent areas of permissible operation within which any application of the JAN5Y3WGTA must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.17.13 RATING CHART I. Rating Chart I (Figure 3-79) is based on maximum rated peak inverse voltage per plate (epx) of 1550 volts and maximum rated d-c output current per plate (Io/p) of 70 milliamperes. Point C corresponds to the simultaneous occurrence of these two ratings, permissible only under choke-input filter conditions. Point E is derived from life test conditions of rated d-c output current into capacitor input filter. The area DCE is restricted to choke input service only.

3.17.14 RATING CHART II. Rating Chart II (Figure 3-80), for capacitor input filter applications, is based on maximum rated d-c output current per plate of 70 milliamperes and maximum rated steady state peak plate current of 415 milliamperes per plate. Rectification efficiency must not exceed 0.63 under conditions of maximum rated d-c output current (See paragraph 3.3.5.) .

3.17.15 RATING CHART III. Rating Chart III (Figure 3-81), for capacitor input filter applications, is based on maximum rated surge current (i surge) of 1.4 amperes per plate. Minimum permissible series resistance (Rs) is approximately 350 ohms per plate under conditions of maximum permissible supply voltage.

3.17.16 OTHER CONSIDERATIONS.

3.17.17 HEATER VOLTAGE. For a discussion of heater voltage considerations, see paragraph 3.3.9.

3.17.18 ALTITUDE. Figure 3-82 is a rating chart showing the relationship of altitude with voltage and current. Refer also to paragraph 3.3.7 for a discussion of altitude considerations.

3.17.19 TYPICAL CHARACTERISTICS.

3.17.20 Figure 3-83 presents the static plate characteristic of JAN-5Y3WGTA, reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes connot be derived from the specification since a minimum limit only on emission is specified.

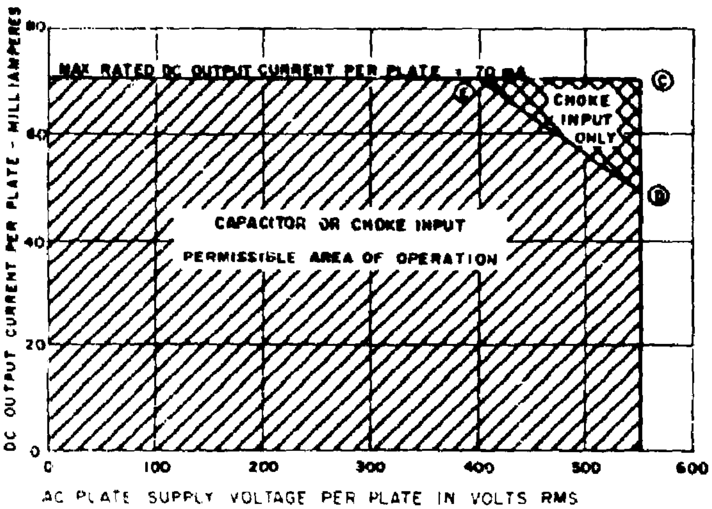


Figure 3-79. Rating Chart I for Tube Type JAN-5Y3WGTA Showing Permissible Operating Area for Choke and Capacitor Input Circuits

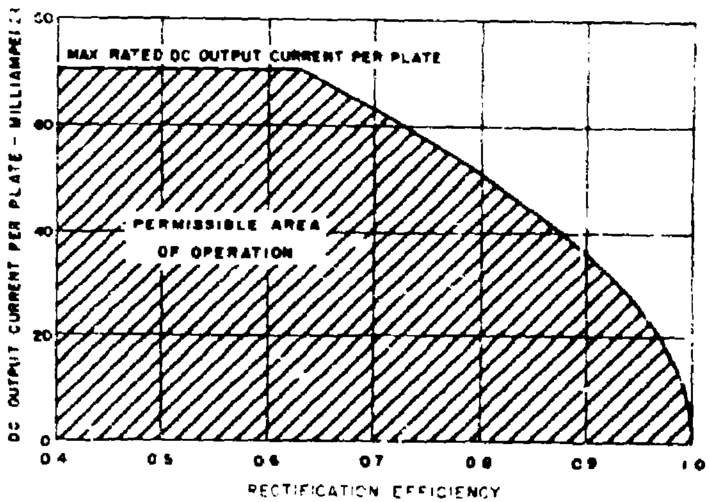


Figure 3-80. Rating Chart II for Tube Type JAN-5Y3WGTA Showing Permissible Operating Area for Capacitor Input Filter Operation

With Series Inductance, Series Resistance may be less than shown provided i Surge Rating of 1.4 amps is not exceeded .

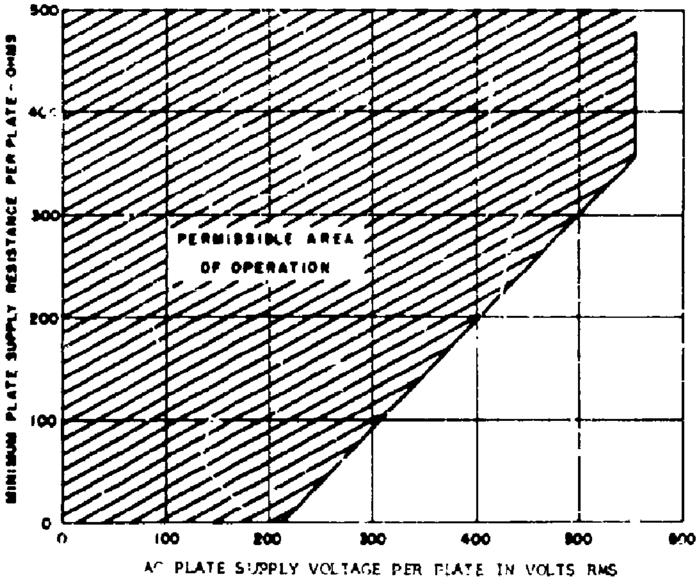


Figure 3-81. Rating Chart III for Tube Type JAN-5Y3WGTA Showing Minimum Allowable Resistance Effectively in Series with Each Plate of Rectifier Tube for Any Allowable A-C Plate Voltage

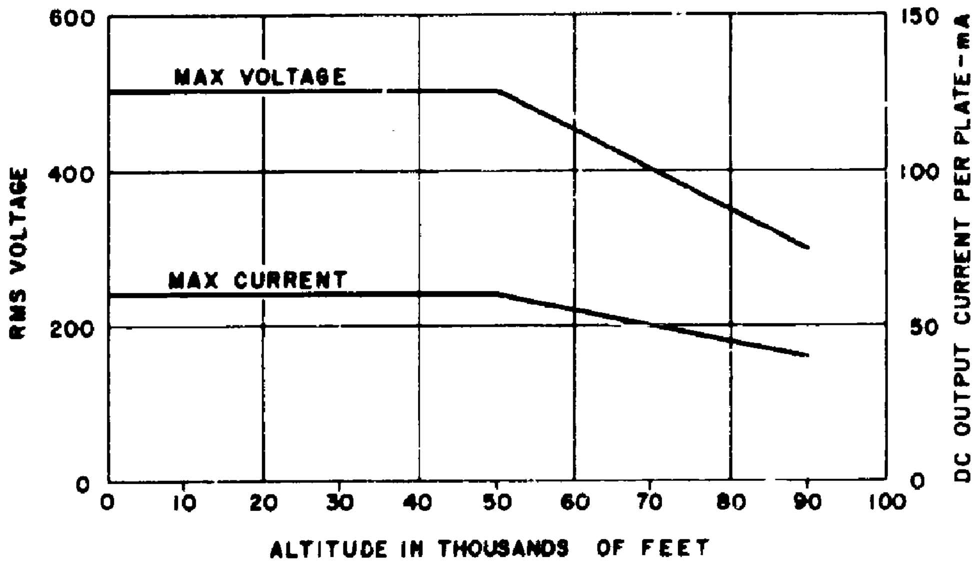


Figure 3-82. Rating Chart IV for Tube Type JAN-5Y3WGTA; Altitude vs. Voltage and Current

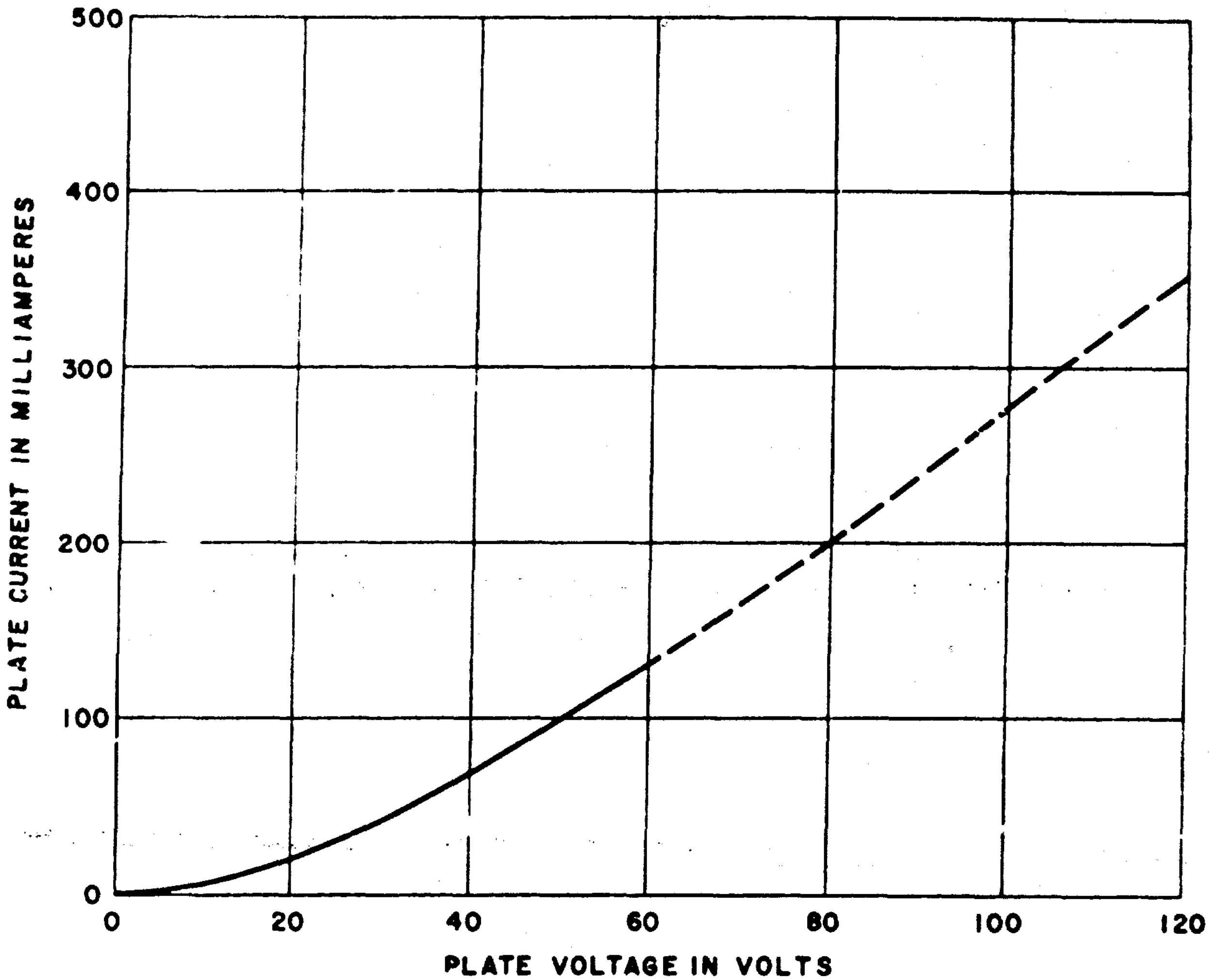


Figure 3-83. Typical Static Plate Characteristics of Tube Type JAN-5Y3WGTA

SECTION 18

TUBE TYPE JAN-6AG7Y

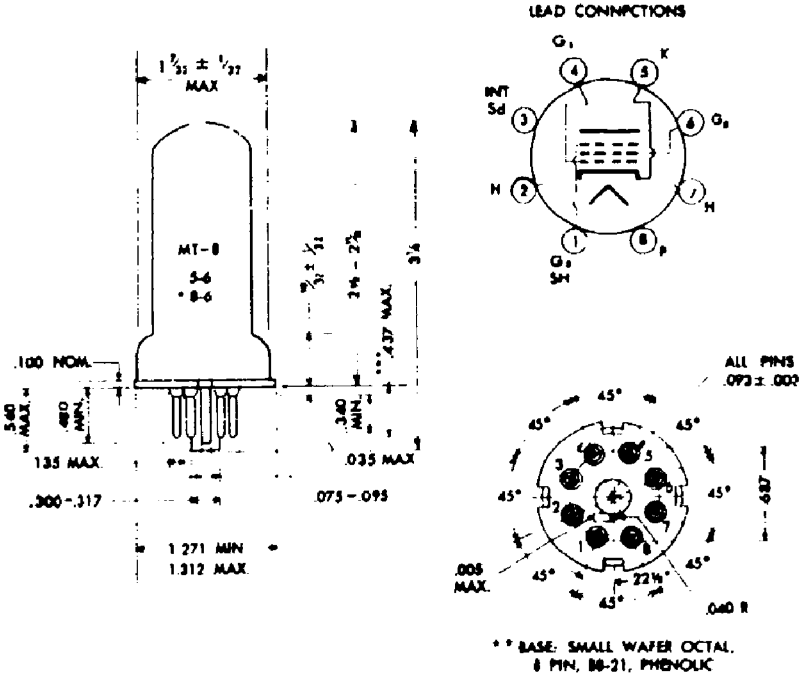
3.18 DESCRIPTION.

3.18.1 The JAN-6AG7, 6AG7Y 1/ is a small wafer octal metal type power amplifier pentode.

3.18.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage, AC or DC . . . . 6.3 V
Heater Current . . . . 610 - 690 mA
Cathode . . . . Coated Unipotential

3.18.3 MOUNTING. Not specified.



ALL DIMENSIONS IN INCHES
*REFERS TO JETEC PUBLICATION J5-G2-1, JANUARY 1949
**REFERS TO JETEC PUBLICATION J0-G3-1, FEBRUARY 1949
***ON FINISHED TUBE, ADD 0.030 FOR SOLDER

Figure 3-84. Outline Drawing and Base Diagram of Tube Type JAN-6AG7Y

1/ The values and specification comments presented in this section are related to MIL-E-1/45B dated 23 August 1955.

3.18.4 RATINGS, ABSOLUTE SYSTEM.

3.18.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 10% V
Plate Voltage	330 Vdc
Reference MIL-E-1 Section 6.5.1.1 Plate Voltage	
* Screen Grid Voltage	330 Vdc
* Cathode Current Maximum	95 mAdc
Plate Dissipation	9.0 W
* Screen Grid Dissipation	1.5 W
Altitude Rating	10,000 ft

3.18.6 TEST CONDITIONS AND CHARACTERISTICS.

3.18.7 Test conditions and characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	300 Vdc
Control Grid Voltage, Ec1	-3 Vdc
Screen Grid Voltage, Ec2	150 Vdc

3.18.8 ACCEPTANCE TEST LIMITS.

3.18.9 Table 3-24 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/45B dated 23 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.18.10 APPLICATION.

3.18.11 Figure 3-85 shows the permissible operating area for JAN-6AG7Y as defined by the ratings in MIL-E-1/45B dated 23 August 1955. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7 of this Manual.

* No test at this rating exists in the specification

TABLE 3-24. ACCEPTANCE TEST LIMITS OF JAN-6AG7Y

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		610	690	---	---	mA
Transconductance (1)	Sm		9200	14200	---	---	umhos
Plate Current (1)	Ib		20	40	---	---	mAdc
Plate Current (2)	Ib	Eb = 150 Vdc; Ecl = -20 Vdc	---	100	---	---	uAdc
Emission	Is	Eb = Ecl = Ec2 = 20 Vdc	180	---	---	---	mAdc
Screen Grid Current	Ic2		4.0	9.0	---	---	mAdc
Power Output	Po	Esig = 2.1 Vac; Rp = 2000	2.4	---	1.6	---	W
Capacitance	Cglp	Ef = 0	---	0.060	---	---	uuf
(Without shield)	Cin	Ef = 0	11.5	14.5	---	---	uuf
	Cout	Ef = 0	6.5	8.5	---	---	uuf
Grid Current	Ic		0	-2.0	---	---	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100	0	40	---	---	uAdc
	Ihk	Ehk = -100	0	-40	---	---	uAdc

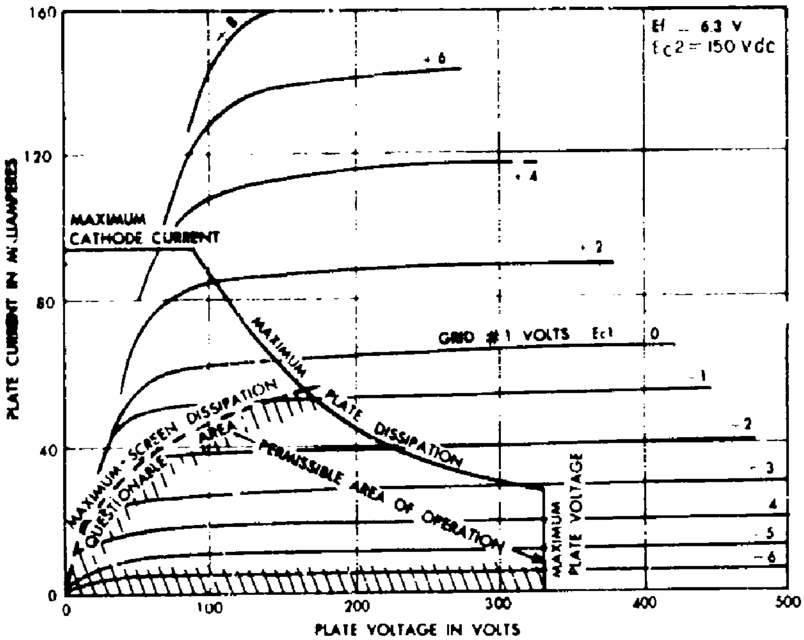


Figure 3-85. Typical Static Plate Characteristics of JAN-6AG7Y; Permissible Area of Operation

3.18.12 The following table lists general considerations for the application of this type. The number refer to the applicable section or paragraph of this Manual.

TABLE 3-25. APPLICATION PRECAUTIONS FOR JAN-6AG7Y

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9

Voltage (cont.)

Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9

TABLE 3-25. APPLICATION PRECAUTIONS FOR JAN-6AG7Y (CONT.)

Current (cont.)

Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16

Resistance (cont.)

Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.18.13 VARIABILITY OF CHARACTERISTICS.

3.18.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.18.15 The chart below presents the limit behavior of static plate characteristics for JAN-6AG7Y as defined by MIL-E-1/45B, dated 23 August 1955.

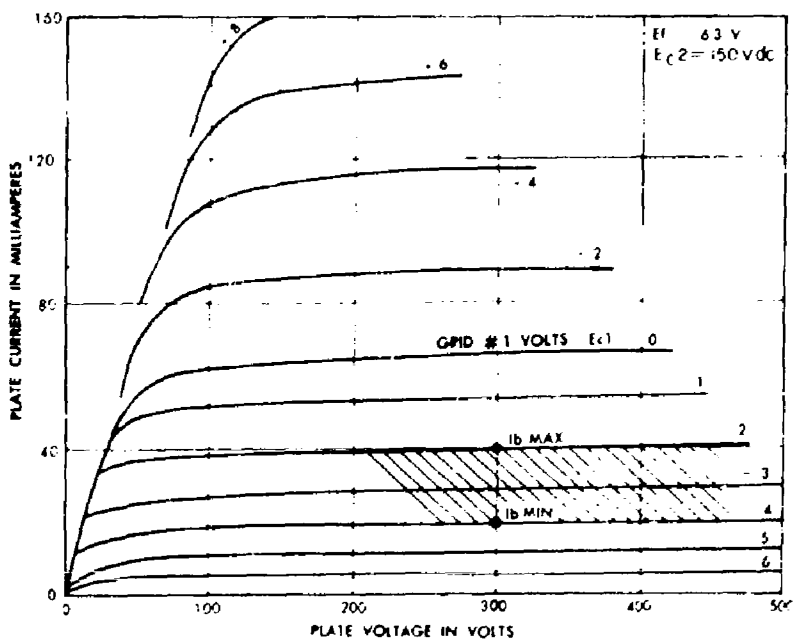


Figure 3-86. Limit Plate Characteristics of JAN-6AG7Y

3.18.16 The next chart presents the limit behavior of transfer data for JAN-6AG7Y as defined by the specification.

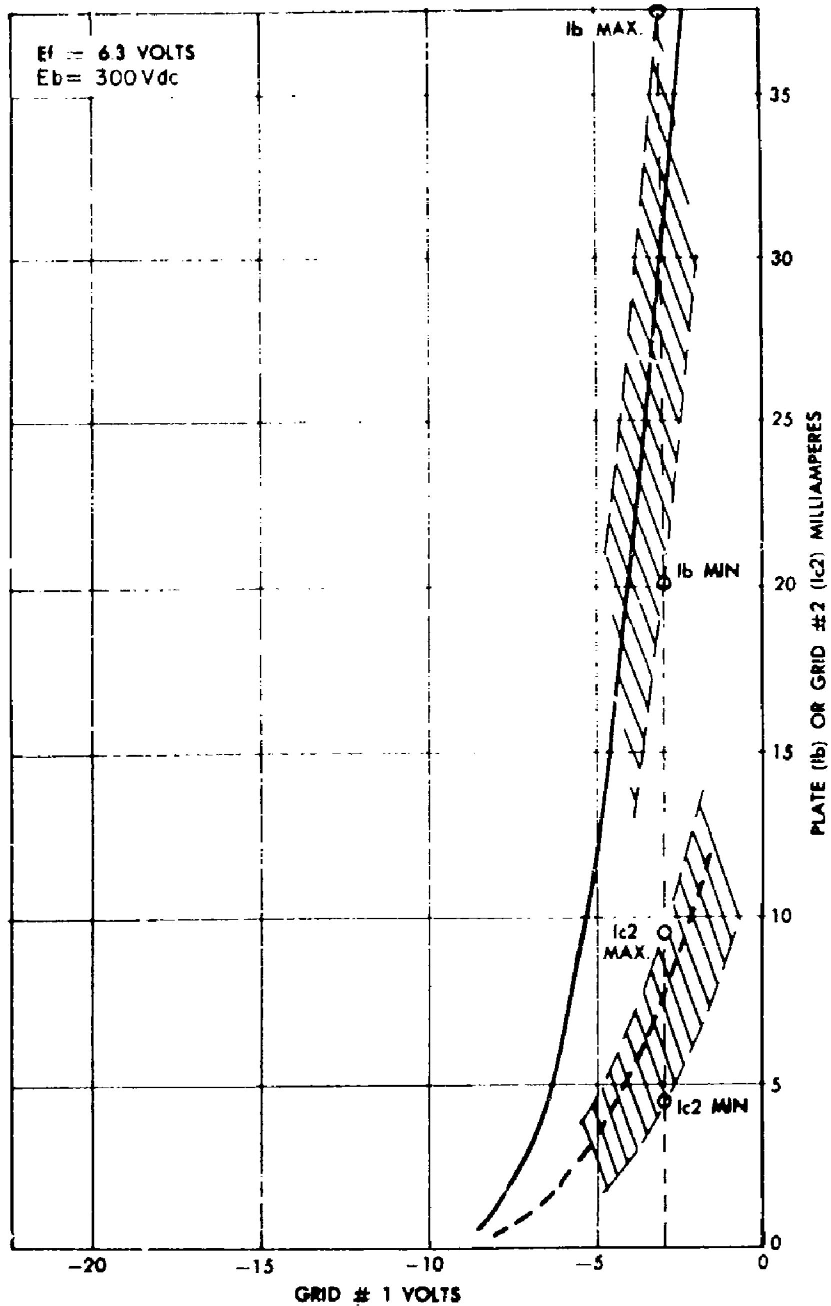


Figure 3-87. Limit Transfer Characteristics of JAN-6AG7Y

3.18.17 DESIGN CENTER CHARACTERISTICS.

3.18.18 These typical curves nave been obta. ed from current data being published by the original RETMA registrant of this type.

3.18.19 Figure 88 represents the typical static plate behavior of JAN-6AG7Y.

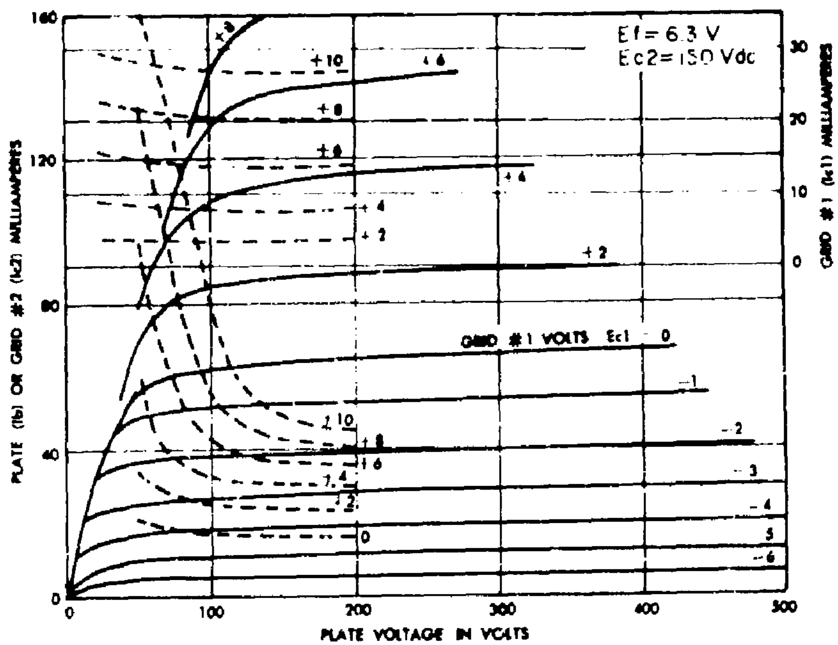


Figure 3-88. Typical Static Plate Characteristics of JAN-6AG7Y; Parametric in Ec1

3.18.20 Figure 3-89 represents the typical transfer behavior of the tube type with parametric variability of screen grid voltage.

3.18.21 Figure 3-90 represents typical static plate behavior at a fixed screen grid voltage of 300 Vdc.

3.18.22 Figure 3-91 represents the parametric behavior of the zero bias line with varying screen voltage as static plate data.

3.18.23 Figure 3-92 represents the typical transfer behavior of the characteristic Sm, parametric in screen grid voltage, Ec2.

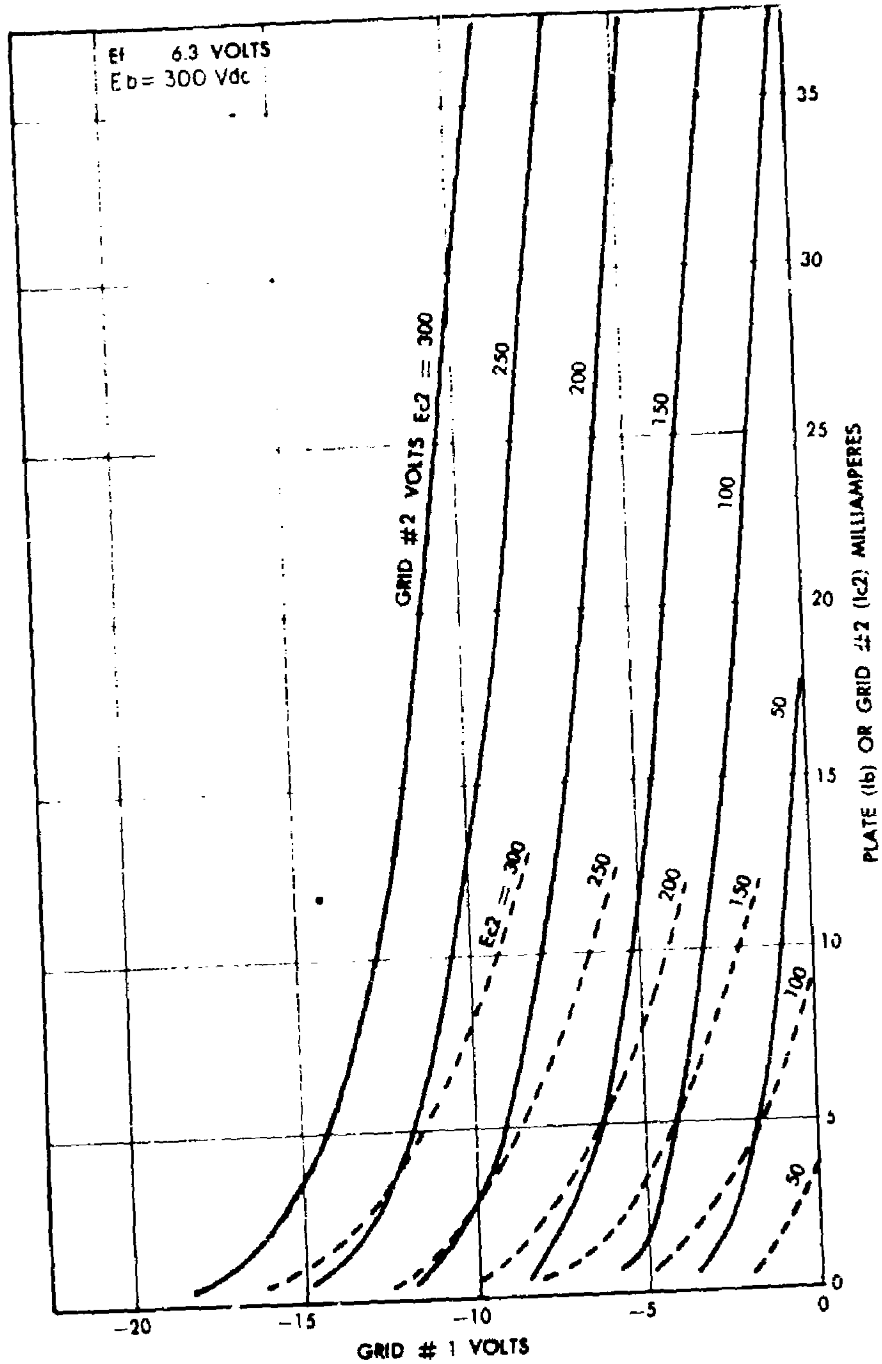


Figure 3-89. Typical Transfer Characteristics of JAN-6AG7Y

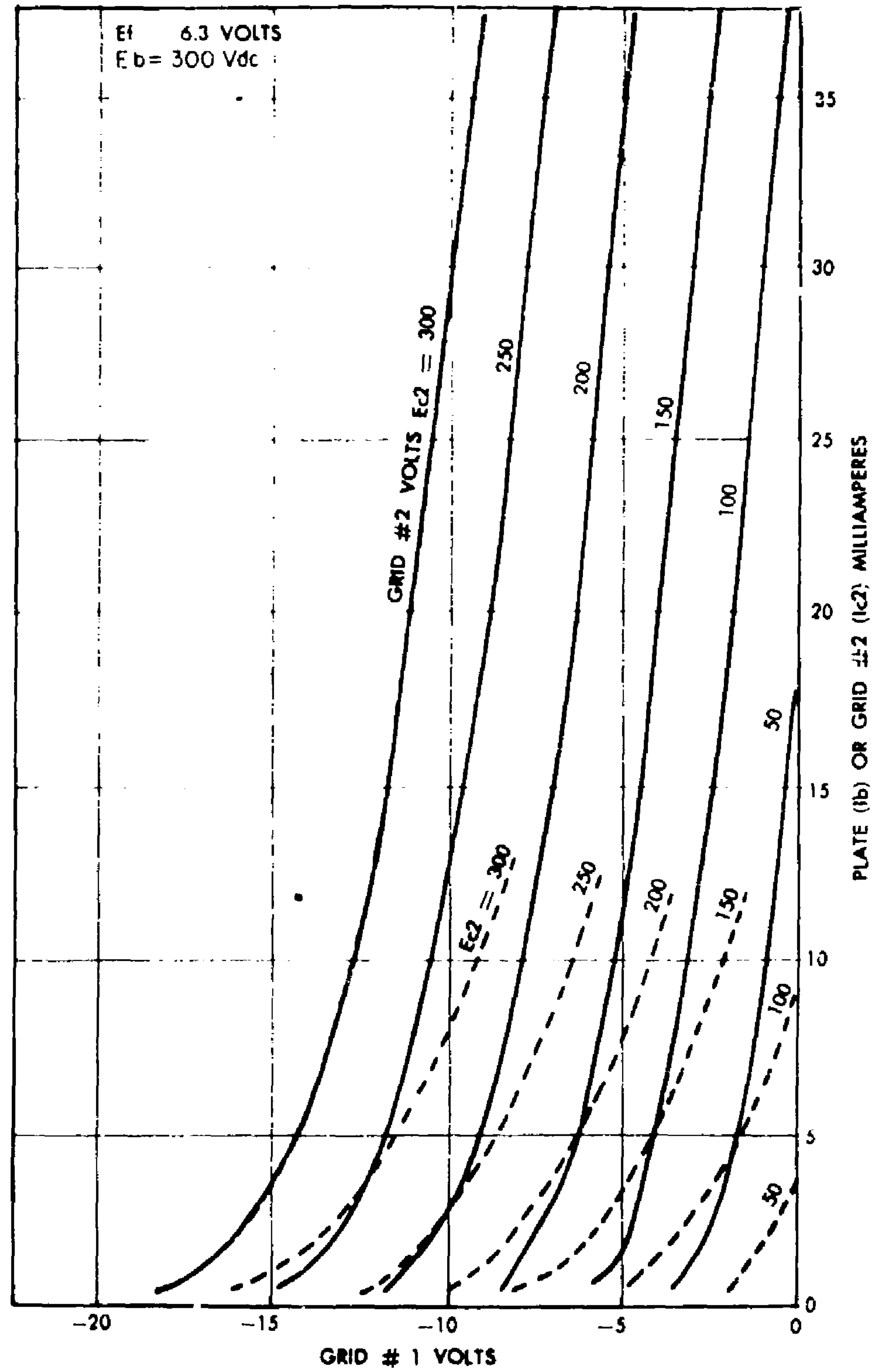


Figure 3-89. Typical Transfer Characteristics of JAN-6AG7Y

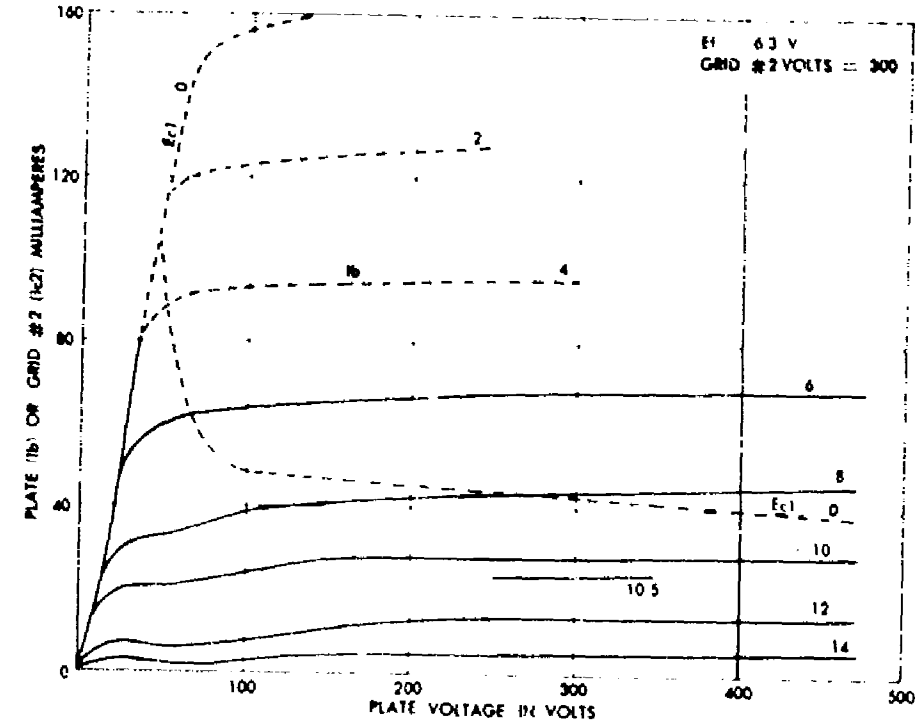


Figure 3-90. Typical Plate Characteristics of JAN-6AG7Y; Parametric in Ec1

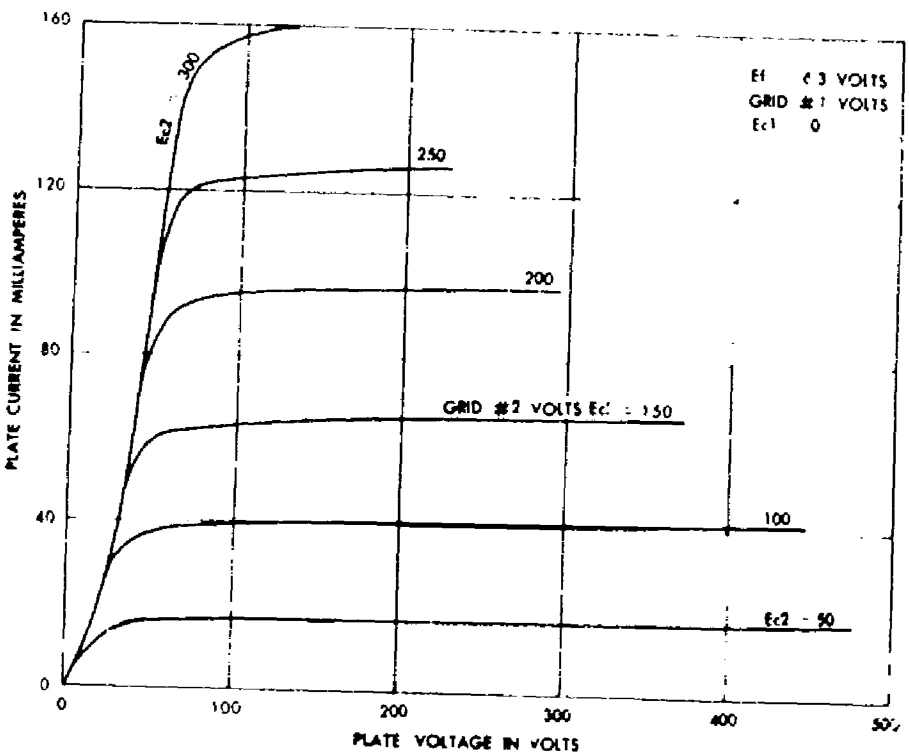


Figure 3-91. Typical Plate Characteristics of JAN-6AG7Y; Parametric in Ec2

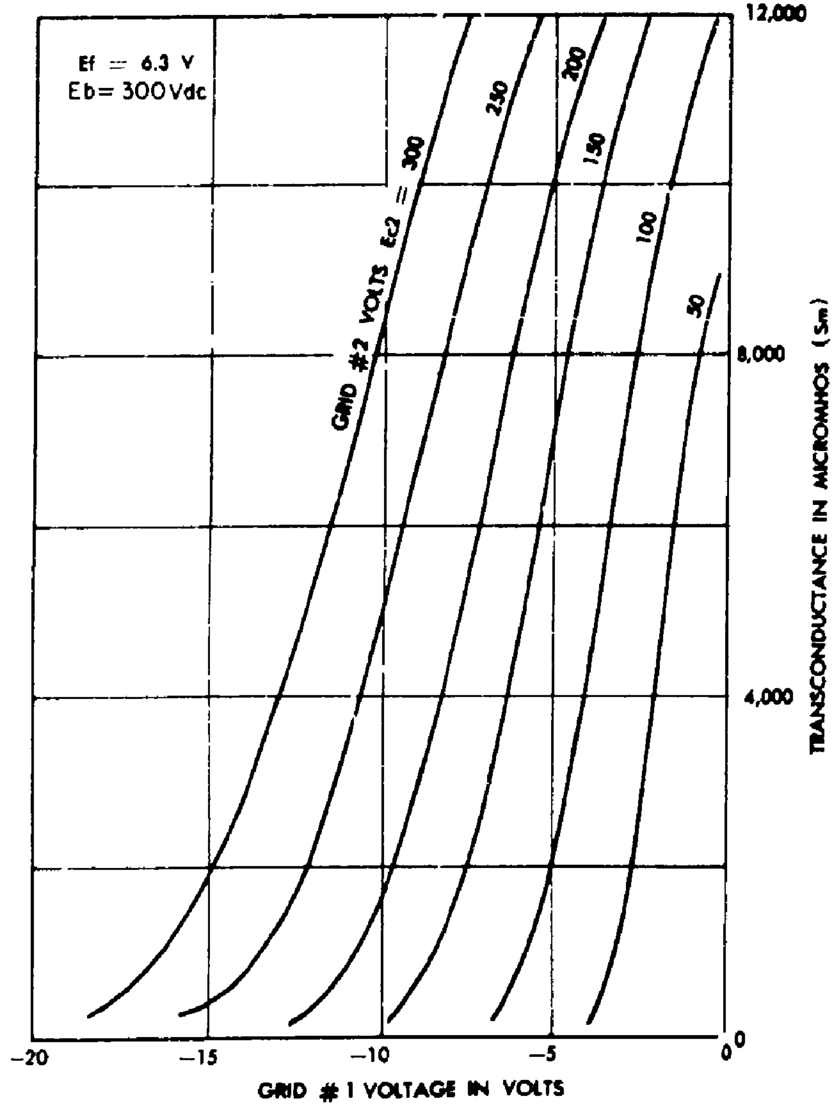


Figure 3-92. Typical Transfer Characteristics of JAN-6AG7Y; Variability of Sm, Parametric in Ec2

SECTION 19

TUBE TYPE JAN-6AH6

3.19 DESCRIPTION.

3.19.1 The JAN-6AH6 1/ is a 7 pin, miniature, RF sharp cutoff pentode with a separate suppressor connection, having a transconductance in the range of 6000 and 11,000 micromhos.

3.19.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage, AC or DC . . . . 6.3 V
Heater Current . . . . 425-475 mA
Cathode . . . . Coated Unipotential

3.19.3 MOUNTING. Not specified.

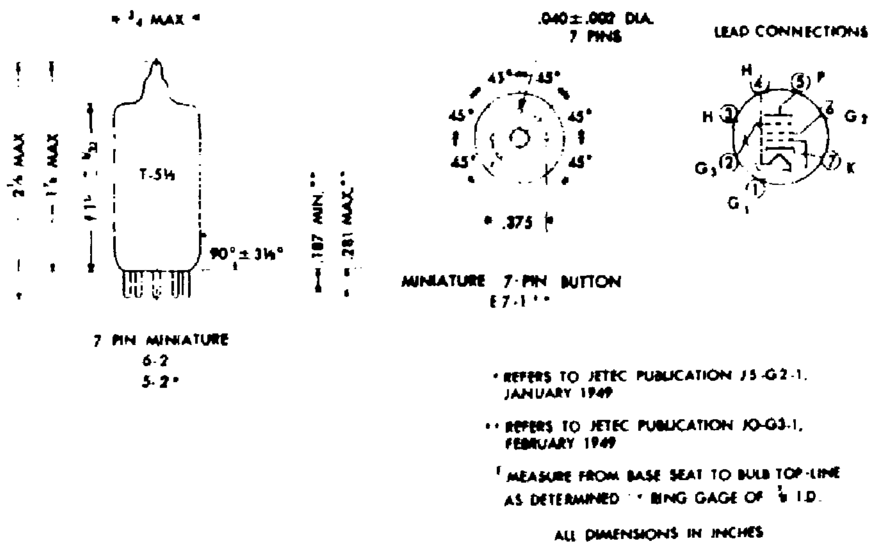


Figure 3-93. Outline Drawing and Base Diagram of Tube Type JAN-6AH6

3.19.4 RATINGS, ABSOLUTE SYSTEM.

3.19.5 The absolute system ratings are as follows:

Heater Voltage . . . . 6.3 V ± 10%
Plate Voltage . . . . 330 Vdc
Reference MIL-E-1C Section 6.5.3.1 Plate Voltage
Screen Grid Voltage . . . . 165 Vdc
Plate Dissipation . . . . 3.3 W
* Screen Grid Dissipation . . . . 0.45 W
Heater Cathode Voltage . . . . 100 V
Altitude Rating . . . . 10,000 ft

* No test at this rating exists in the specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/46 dated 5 February 1953.

3.19.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.19.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef .... 6.3 V
Plate Voltage, Eb .... 300 Vdc
Control Grid Voltage, Ecl .... 0 Vdc
Screen Grid Voltage, Ec2 .... 150 Vdc
Suppressor Grid Voltage, Ec3 .... 0 Vdc
Cathode Resistor, Rk .... 160 ohms

3.19.8 ACCEPTANCE TEST LIMITS.

3.19.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/46 dated 5 February 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-26. ACCEPTANCE TEST LIMITS OF JAN-6AH6

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		425	475	---	---	mA
Transconductance (1)	Sm	Ck = 1000 uf	6000	11000	5300	---	umhos
Plate Current (1)	Ib		7.0	12.5	---	---	mAdc
Plate Current (2)	Ib	Ecl = -10 Vdc	0.0	30.0	---	---	uAdc
Emission	Is	Eb = Ecl = Ec2 Ec3 = 10 Vdc; Rk = 0	40	---	---	---	mAdc
Screen Grid Current	Ic2		1.5	3.8	---	---	mAdc
Capacitance	Cgp	Ef = 0	---	0.020	---	---	uuf
(Shielded as	Cin	Ef = 0	8.0	12.0	---	---	uuf
specified)	Cout	Ef = 0	2.5	4.7	---	---	uuf
Grid Current	Icl		0	-3.0	---	---	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	0	20	---	---	uAdc
	Ihk	Ehk = -100 Vdc	0	-20	---	---	uAdc
Insulation of Electrodes	Rg-all	Eg-all = -300 Vdc	10	---	---	---	Meg
	Rp-all	Ep-all = -500 Vdc	10	---	---	---	Meg

3.19.10 APPLICATION.

3.19.11 The chart below shows the permissible operating area for JAN-6AH6 as defined by the ratings in MIL-E-1/46 dated 5 Feb 1953. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

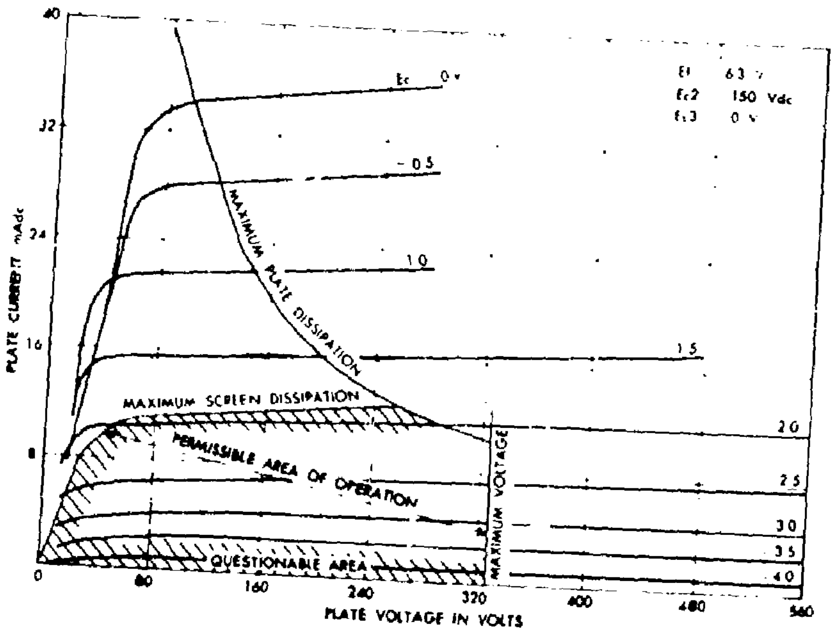


Figure 3-94. Typical Static Plate Characteristics of JAN-6AH6; Permissible Area of Operation

3.19.12 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this manual.

TABLE 3-27. APPLICATION PRECAUTIONS FOR JAN-6AH6

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15
- Fixed, 1.3.8, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35 2.2.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.19.13 VARIABILITY OF CHAI CTERISTICS.

3.19.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification

3.19.15 The chart below presents the limit behavior of static plate characteristics for JAN-6AH6 as defined by MIL-E-1/46 dated 5 Feb 1953.

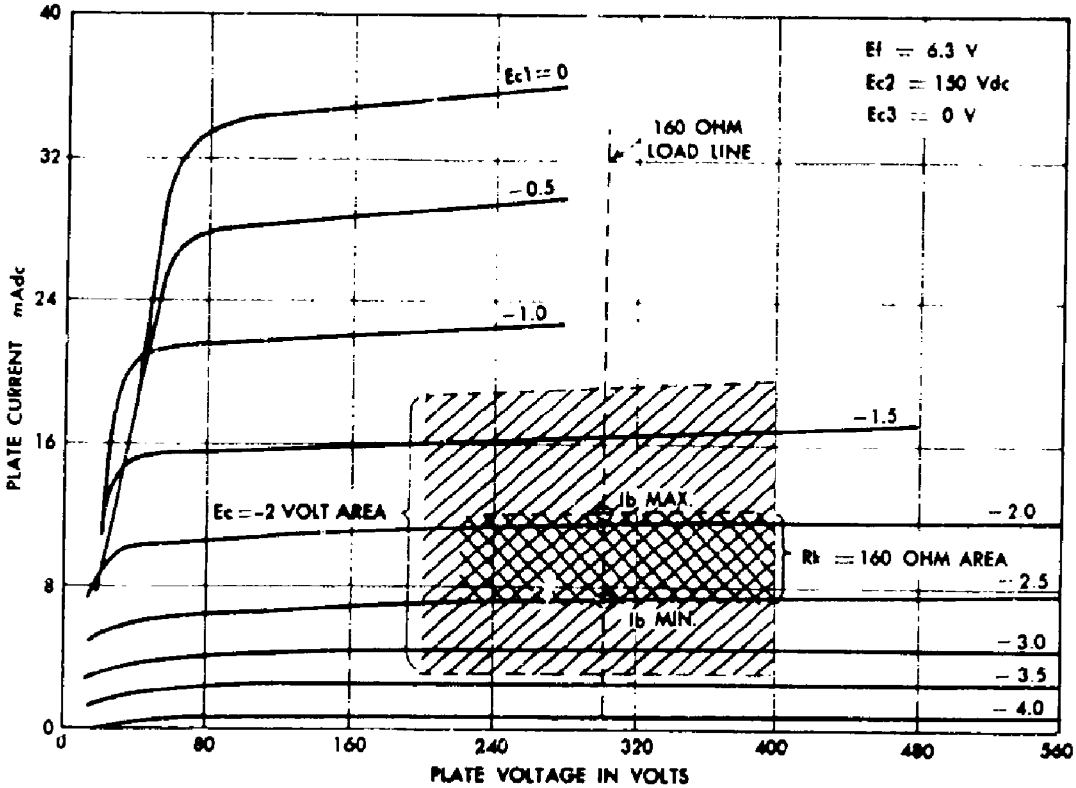


Figure 3-95. Limit Plate Characteristics of JAN-6AH6

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ac-

3.19.16 The chart below presents the limit behavior of transfer data for JAN-6AH6 as defined by MIL-E-1/46 dated 5 February 1953.

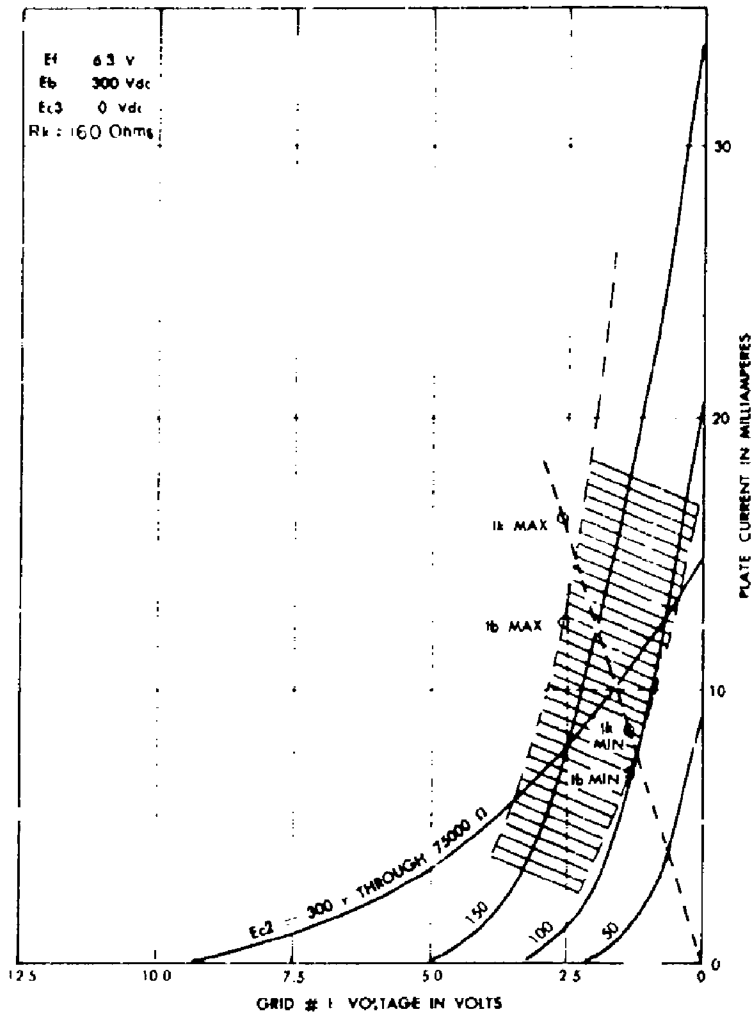


Figure 3-96. Limit Transfer Characteristics of JAN-6AH6

3.19.17 DESIGN CENTER CHARACTERISTICS.

3.19.18 These typical curves have been obtained from current data being published by the original RETMA registrant of this type. The chart below presents the Static Plate Characteristics of JAN-6AH6.

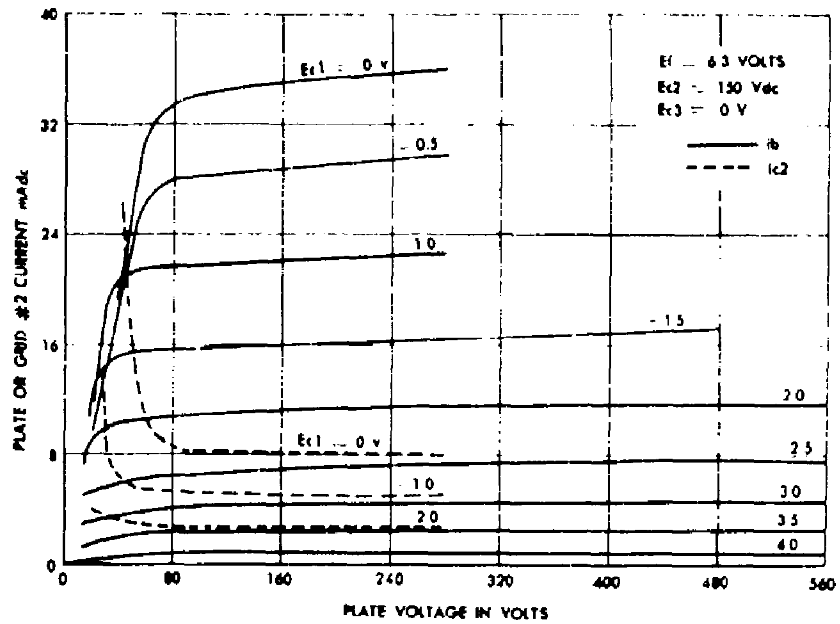


Figure 3-97. Typical Static Plate Characteristics of JAN-6AH6

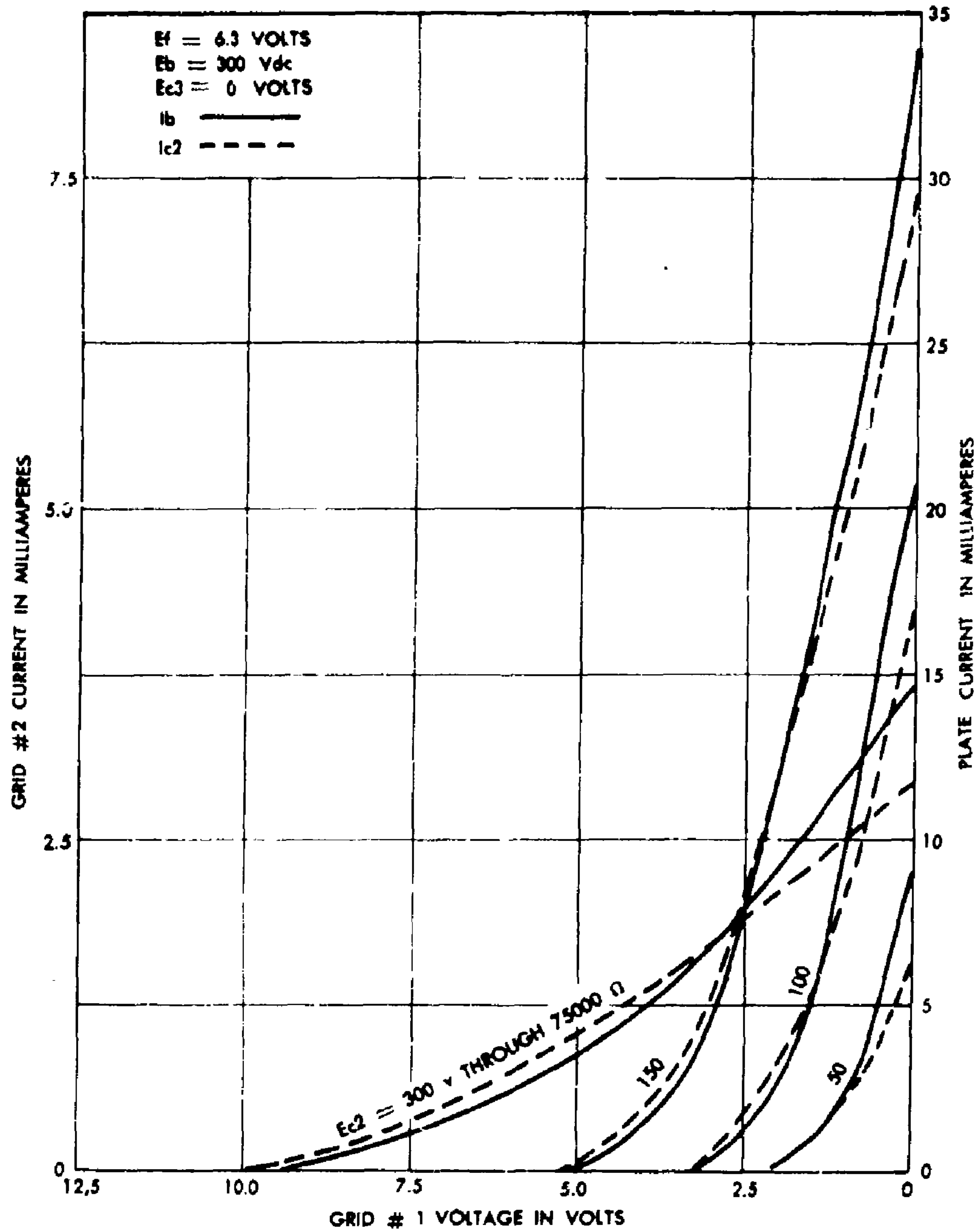


Figure 3-98. Typical Transfer Characteristics of JAN-6AH6

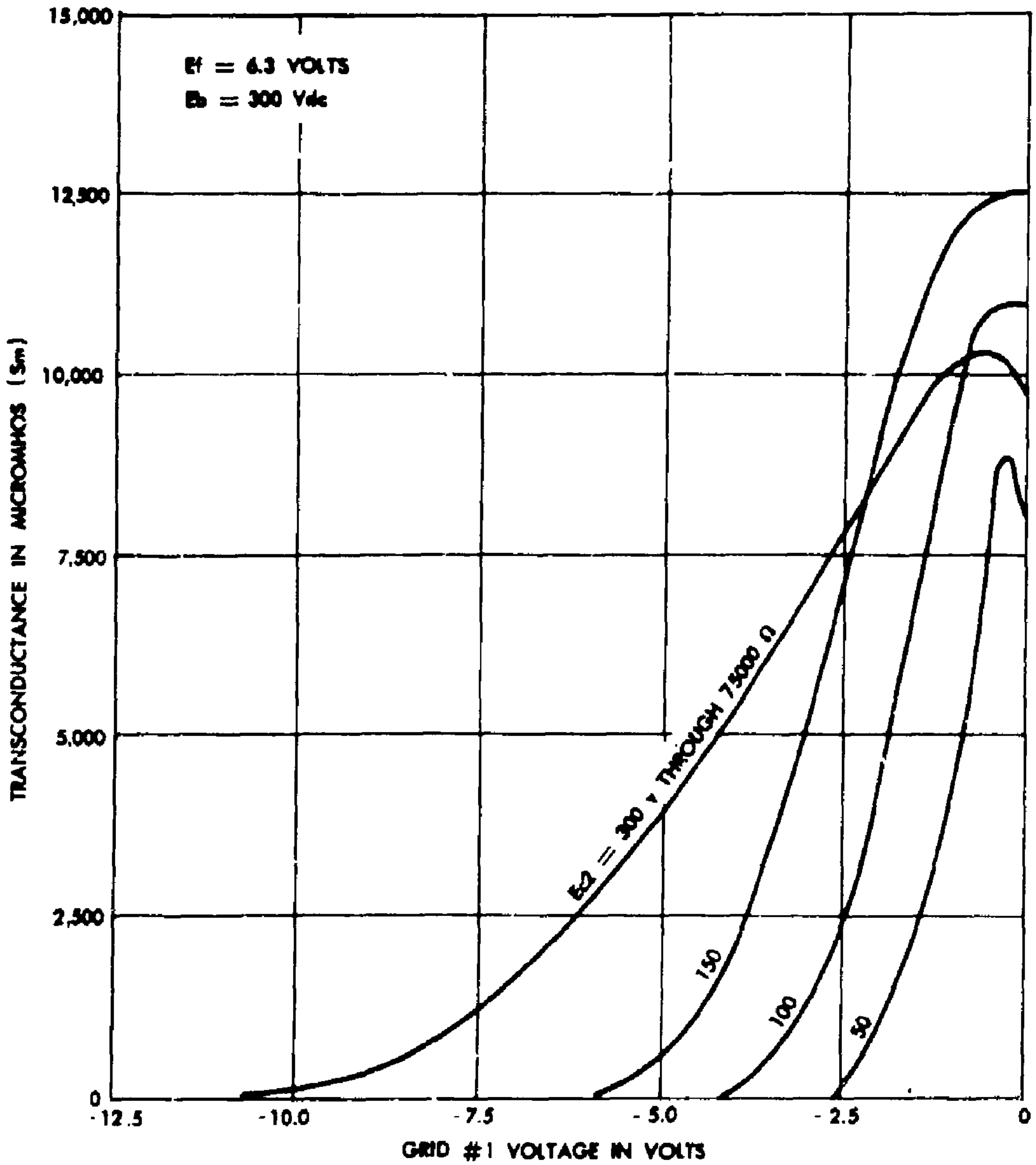


Figure 3-99. Typical Variability of Sm for JAN-6AH6

TUBE TYPE JAN-6AU6WA

3.20 DESCRIPTION.

3.20.1 The JAN-6AU6WA 1/ is a seven pin, miniature, sharp cutoff pentode having a design center transconductance of 5200 micromhos.

3.20.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 300 mA
* Cathode . . . . Coated Unipotential

3.20.3 MOUNTING. Not specified.

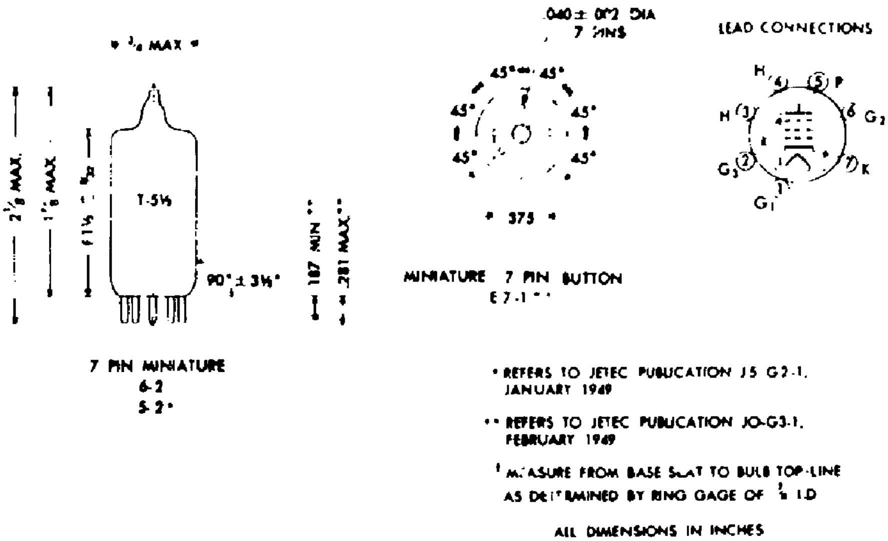


Figure 3-100. Outline Drawing and Base Diagram of Tube Type JAN-6AU6WA

3.20.4 RATINGS, ABSOLUTE SYSTEM.

3.20.5 The absolute system ratings are as follows:

Heater Voltage. . . . . $6.3 \pm 10\%$ V
Plate Voltage . . . . 330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Control Grid Voltage, Maximum . . . . 0 Vdc
Screen Grid Voltage . . . . 165 Vdc

---

* Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

1/ The values and specification comments presented in this section are related to MIL-E-1/1 dated 13 January 1953.

Suppressor Grid Voltage	0 Vdc
Plate Dissipation	3.3 W
Screen Grid Dissipation	0.7 W
Heater-Cathode Voltage	± 100 V
Bulb Temperature	165° C
Altitude	10,000 ft

3.20.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.20.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	250 Vdc
Screen Grid Voltage, Ec2	150 Vdc
Suppressor Grid	Tied to Negative Terminal of Cathode Resistor
Cathode Resistor, Rk	68 ohms
Heater Current, If	300 mA
Plate Current, Ib	10.6 mA
Transconductance, Sm	5200 umhos
Screen Grid Current	4.3 mAdc
Input Capacitance	6.0 uuf
Output Capacitance	4.9 uuf

3.20.8 ACCEPTANCE TEST LIMITS.

3.20.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/1 dated 13 January 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-28. ACCEPTANCE TEST LIMITS OF JAN-6AU6WA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		275	325	275	325	mA
Transconductance (1)	Sm		4150	6250	3600	6250	umhos
Transconductance (2)	Sm	Ef = 5.5 V	3900	---	---	---	umhos
Plate Current (1)	Ib		8.0	13.5	---	---	mAdc
Plate Current (2)	Ib	Ec1 = -9 Vdc Rp = 0.1 Meg Rk = 0; Ck = 0	---	35	---	---	uAdc
Screen Grid Current	Ic2		2.6	6.0	---	---	mAdc
Capacitance	Cg1p	Ef = 0	---	.0035	---	---	uuf
(No shield)	Cin	Ef = 0	4.8	7.2	---	---	uuf
	Cout	Ef = 0	3.9	5.9	---	---	uuf
Grid Current	Ic	Ec1 = -1 Vdc Rg1 = 0.25 Meg	---	-1.0	---	-1.0	uAdc
Grid Emission	Isc1	Ef = 7.5 V; Ec1= -10 Vdc; Rg1 = .25 Meg. Rk = 0; Ck = 0	---	-2.0	---	---	uAdc
Heater Cathode Leakage	Ihk	Ehk = +100 Vdc	---	10	---	10	uAdc
	Ihk	Ehk = -100 Vdc	---	10	---	-10	uAdc
Insulation of Electrodes		Ef = 6.3 V					
	Rg-all	Eg1 - all = -100	100	---	50	---	Meg
	Rp-all	Vdc; Ep-all = 300 Vdc	100	---	50	---	Meg

3.20.10 APPLICATION.

3.20.11 The chart below shows the permissible operating area for JAN-6AU6WA as defined by the ratings in MIL-E-1/1 dated 13 January 1953. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

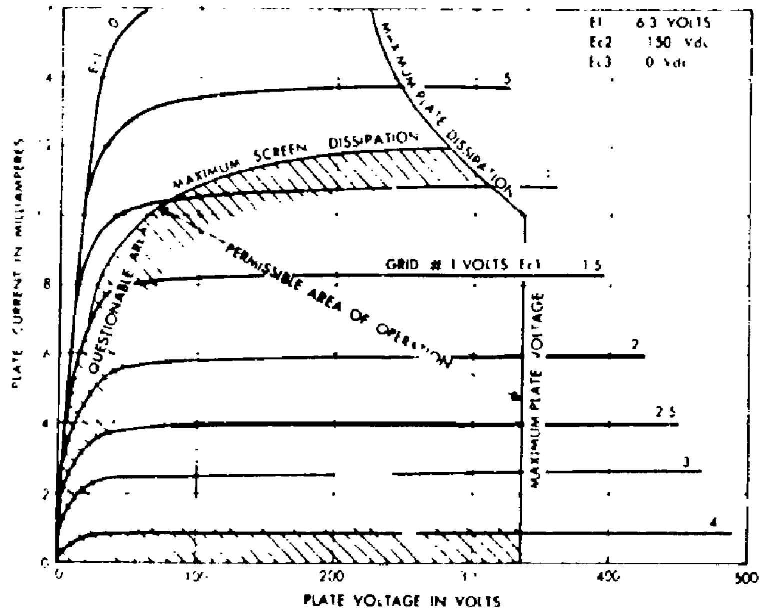


Figure 3-101. Typical Static Plate Characteristics of JAN-6AU6WA; Permissible Area of Operation

3.20.12 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-29. APPLICATION PRECAUTIONS FOR JAN-6AU6WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt 3.2.21
AC Operation, 1.3.20, 3.2.18
Screen Grid:

Voltage (Cont.)

Supply, 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Fixed, 1.3.8, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23 3.2.9
Screen Grid, 3.2.3

Current (Cont.)

Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.20.13 VARIABILITY OF CHARACTERISTICS.

3.20.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.20.15 The chart below presents the limit behavior of static plate characteristics for JAN-6AU6WA as defined by MIL-E-1/1 dated 13 January 1953.

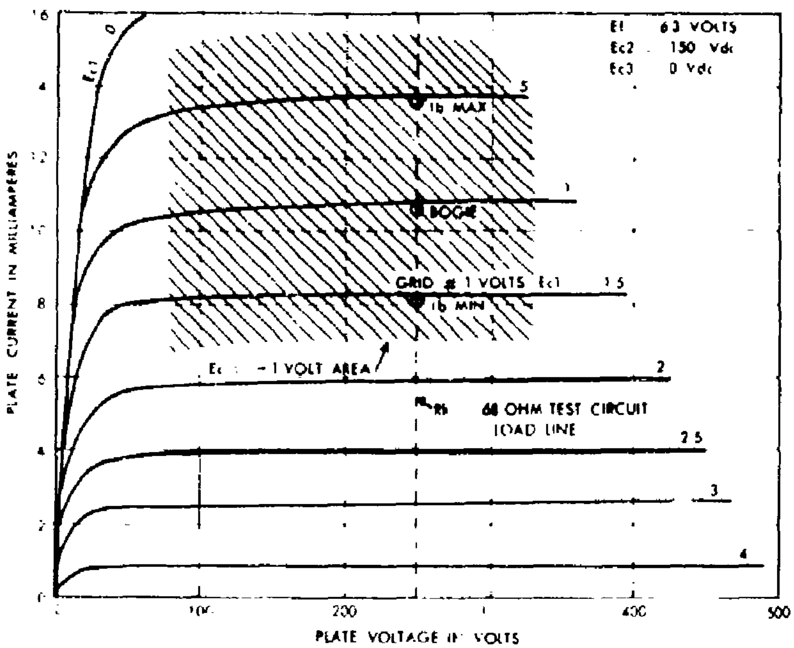


Figure 3-102. Limit Plate Characteristics of JAN-6AU6WA

3.20.16 Figure 3-103 presents the limit behavior of transfer data for JAN-6AU6WA as defined by MIL-E-1/1 dated 13 January 1953.

3.20.17 DESIGN CENTER CHARACTERISTICS.

3.20.18 The following typical curves portrayed as Figures 3-103 through 3-107, have been obtained from current data being published by the original RETMA registrant of this type.

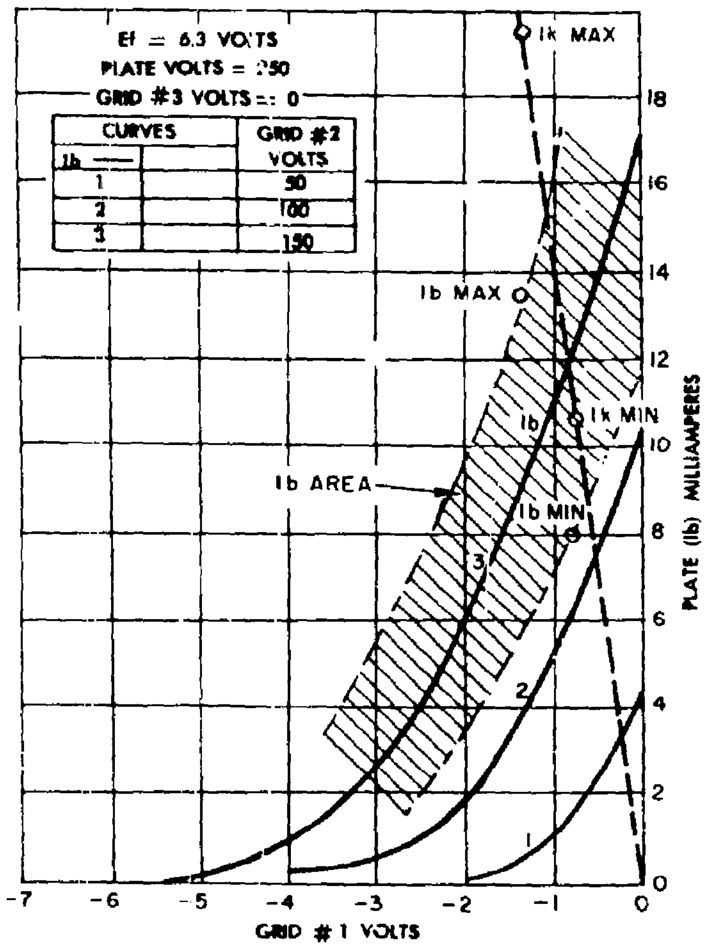


Figure 3-103. Limit Transfer Characteristics of JAN-6AU6WA; Parametric in Ec2

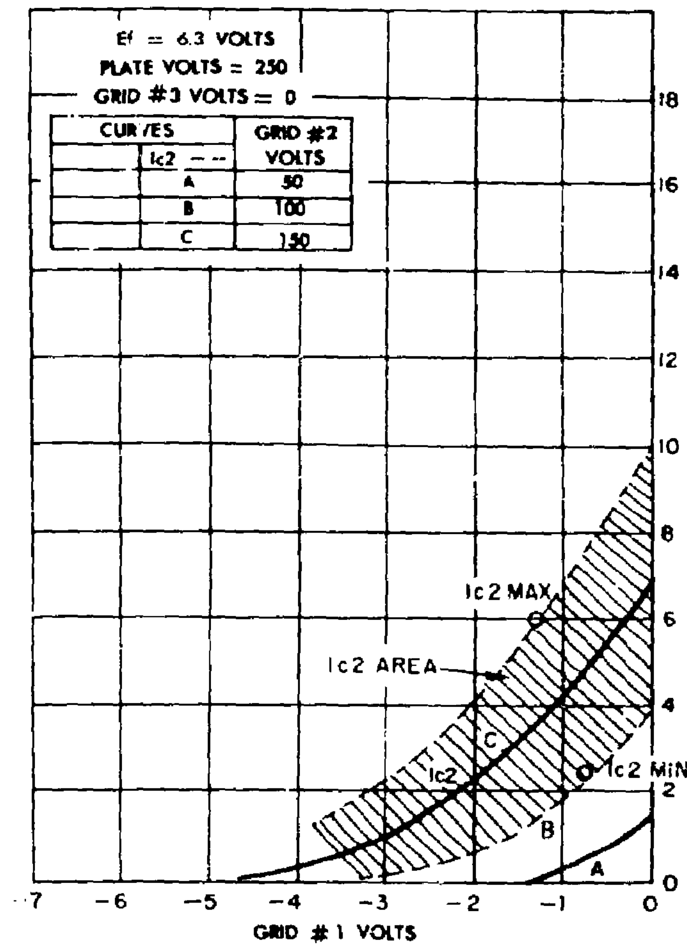


Figure 3-104. Screen Grid Transfer Characteristics of JAN-6AU6WA; Parametric in Ec2

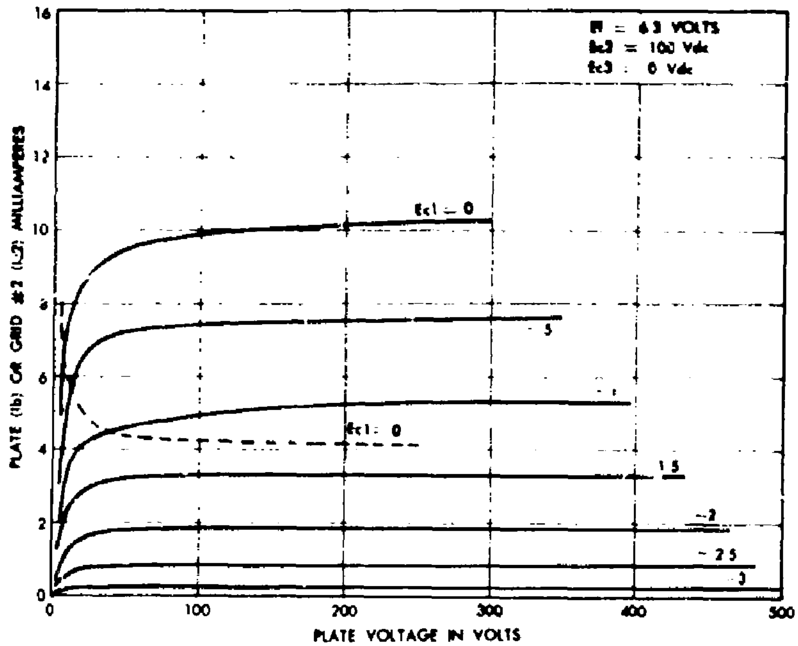


Figure 3-105. Typical Plate Characteristics of JAN-6AU6WA; Ec2 = 100 Vdc

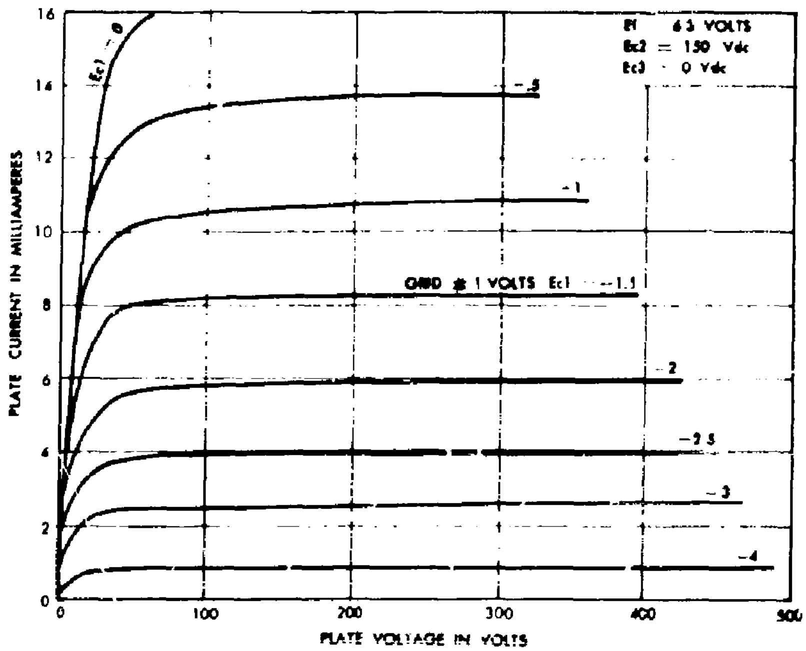


Figure 3-106. Typical Plate Characteristics of JAN-6AU6WA; Ec2 = 150 Vdc

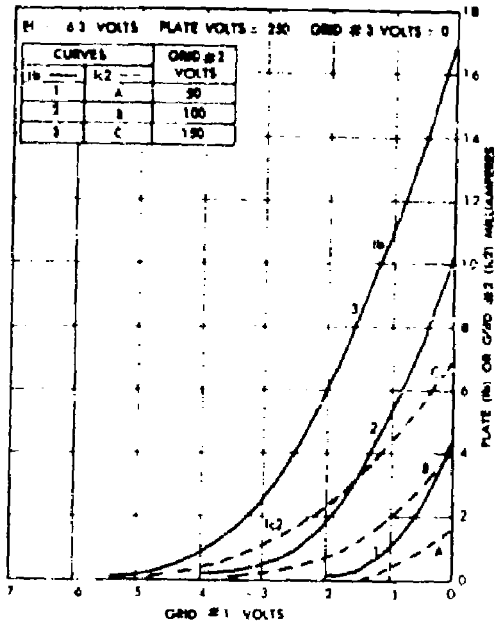


Figure 3-107. Typical Transfer Characteristics of JAN-6AU6WA

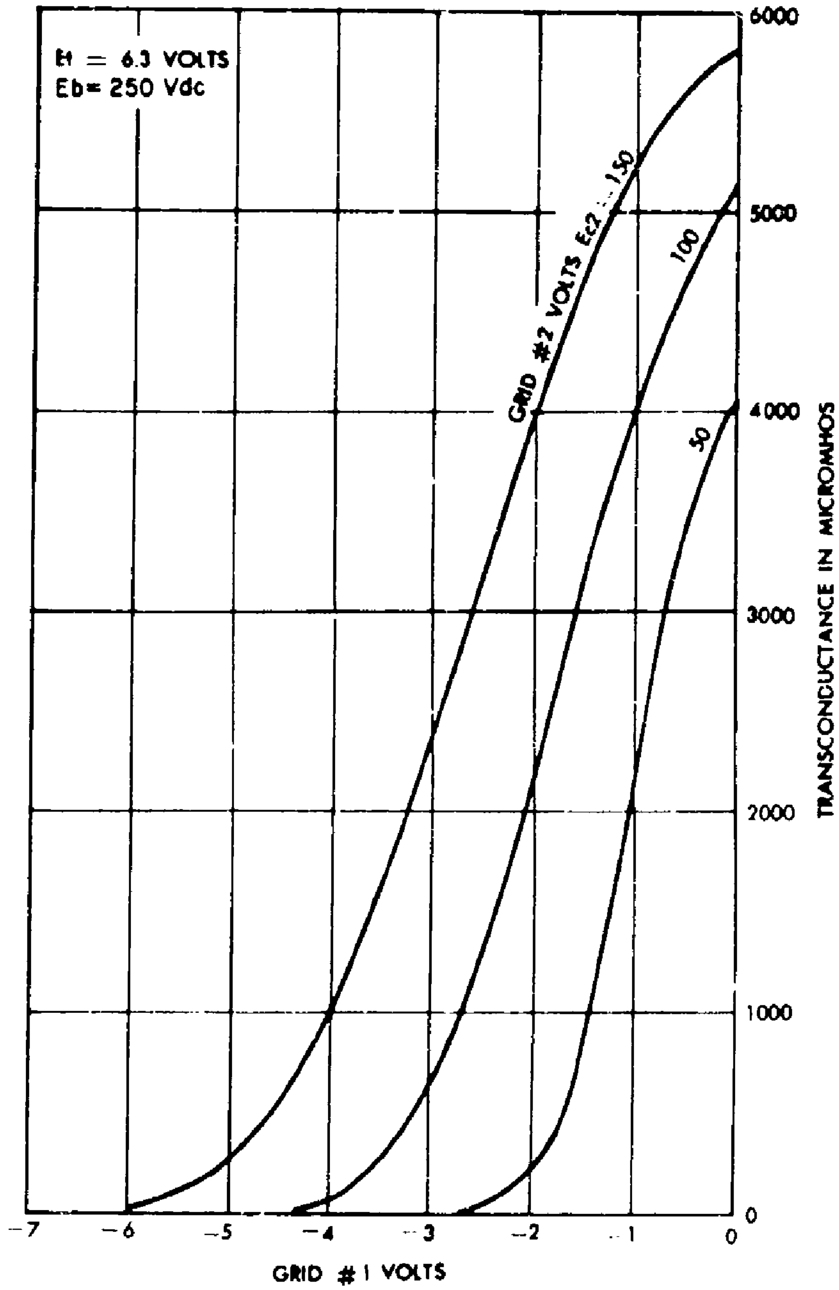


Figure 3-108. Typical Variation of Sm with Ec1 for JAN-6AU6WA

SECTION 21

TUBE TYPE JAN-6BG6G

3.21 DESCRIPTION.

3.21.1 The JAN-6BG6G 1/ is an 8 pin octal base, double ended, glass envelope beam power pentode.

3.21.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage, AC or DC . . . . 6.3 V
Heater Current . . . . 0.81 to 0.0.99 A
Cathode . . . . Coated Unipotential

3.21.3 MOUNTING. Not specified.

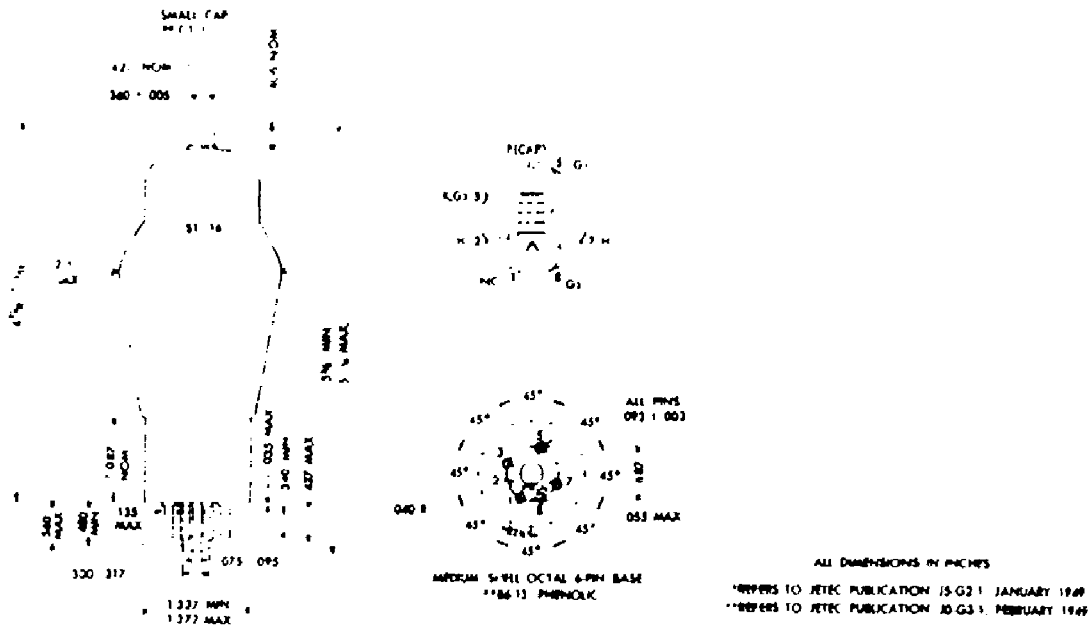


Figure 3-109. Outline Drawing and Base Diagram of Tube Type JAN-6BG6G

3.21.4 RATINGS, ABSOLUTE SYSTEM.

3.21.5 The absolute system ratings are as follows:

Heater Voltage. . . . . 6.3 V ± 10%
Plate Voltage . . . . 550 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
* Peak Forward anode Voltage, epy . . . . 6600 v
Duration of pulse not to exceed 10 u sec.
Duty Cycle not to exceed 0.15

---

* No test of operation at this rating exists in the specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/53A dated 5 February 1953.

Screen Grid Voltage	1.385 Vdc
Control Grid Voltage	50 Vdc
Peak Inverse Control Grid Voltage, egx	300 v
Duration of pulse not to exceed 10 usec	
Duty cycle not to exceed 0.15	
** Plate Current	110 mAdc
* Screen Grid Dissipation	3.5 W
Plate Dissipation	25 W
Heater Cathode Leakage	135 V
* Control Grid Series Resistance	0.47 Meg
* Altitude Rating	10,000 ft

3.21.6 TEST CONDITIONS.

3.21.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	600 Vdc
Control Grid Voltage, Ec1	30 Vdc
Screen Grid Voltage, Ec2	300 Vdc

3.21.8 ACCEPTANCE TEST LIMITS.

3.21.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/53A dated 14 January 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test of operation at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-30. ACCEPTANCE TEST LIMITS OF JAN-6BG6G

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		810	990	---	---	mA
Plate Current (1)	Ib		24	55	---	---	mAdc
Plate Current (2)	Ib	Ec1 = -100 Vdc	---	0.5	---	---	mAdc
Emission	Is	Eb = Ec1 = Ec2 = 50 Vdc	300	---	225	---	mAdc
Grid Current	Ic2		---	4	---	---	mAdc
Capacitance (no shield)	Cgp	Ef = 0	---	0.65	---	---	uuf
	Cin	Ef = 0	10.1	13.9	---	---	uuf
	Cout	Ef = 0	4.9	8.1	---	---	uuf
Grid Current	Ic	Test duration t = 120 Sec.	0	-4	---	---	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	0	100	---	---	uAdc
	Ihk	Ehk = -100 Vdc	0	-100	---	---	uAdc

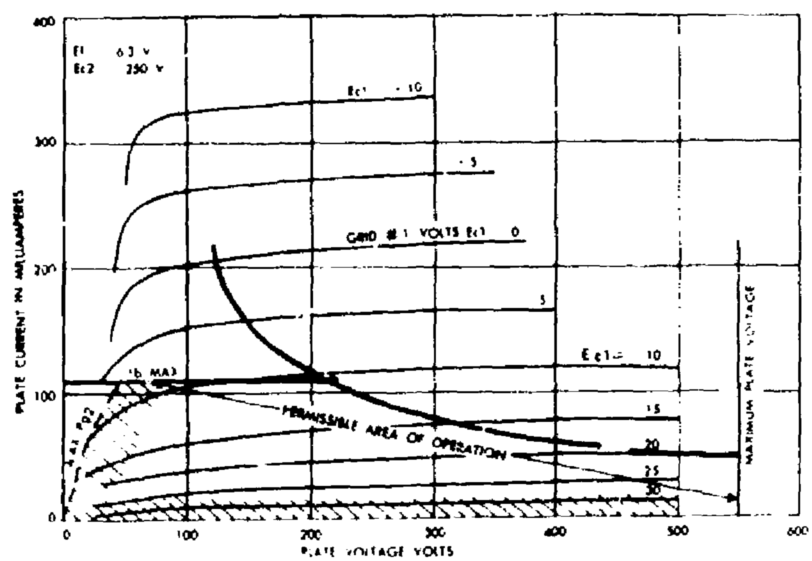


Figure 3-110. Typical Static Plate Characteristics of JAN-6BG6G; Permissible Area of Operation

3.21.10 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-31. APPLICATION PRECAUTIONS FOR JAN-6BG6G

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
  High, 3.2.12
  Low, 3.2.3, 3.2.7
  28 Volt, 3.2.21
  AC Operation, 1.3.20, 3.2.18
Screen Grid:
  Supply, 3.2.8
  Protection, 3.2.22
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
  Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.21.11 VARIABILITY OF CHARACTERISTICS.

3.21.12 The published technical data which describe and define electron tubes, in general, present only average or center values. Consequently, the variation inherent in a typical characteristic curve is frequently overlooked. The variability of the characteristics of JAN-6BG6G are reflected by a study of specifications MIL-E-1/53A. The published technical data for this type does not lead to construction of limit behavior charts. The specification test points, placed near or actually slightly in excess of the maximum ratings, are of little aid in assessing the variability of the type under a design center philosophy.

3.21.13 The designer of equipment, utilizing this type, is therefore directed to a careful study of the specification and in cases of circuit versus tube incompatibility is directed to the methods of correlation study described in paragraph 2.2.5.

3.21.14 DESIGN CENTER CHARACTERISTICS.

3.21.15 These typical curves, portrayed in Figures 3-111 through 3-113, have been obtained from current data being published by the original RETMA registrant of this type.

3.21.16 Figure 3-111 presents the typical static plate behavior of JAN-6BG6G.

3.21.17 Figure 3-112 presents the typical behavior of the zero bias line of this type with a parametric variation of screen grid voltage.

3.21.18 Figure 3-113 presents the typical screen grid current behavior of JAN-6BG6G as a function of plate voltage with parametric variation of screen grid voltage, Ic2.

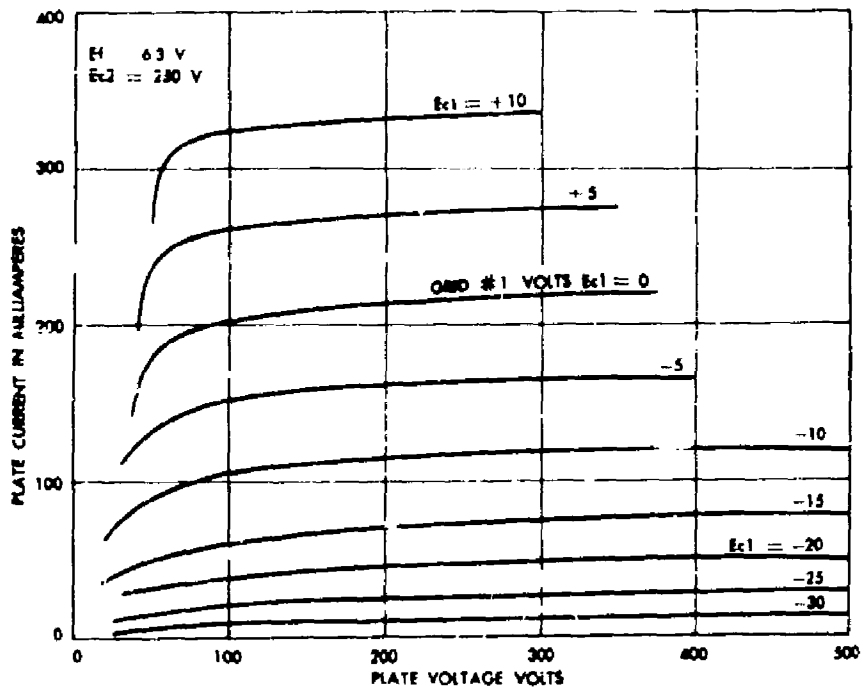


Figure 3-111. Typical Plate Characteristic of JAN-6BG6G; Parametric in Ec 1

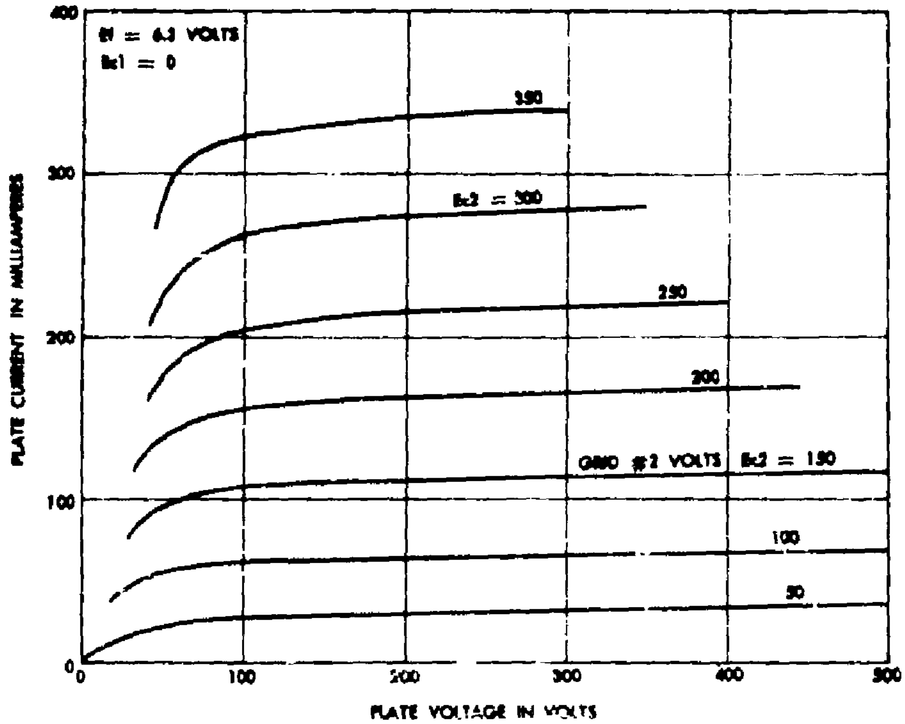


Figure 3-112. Typical Plate Characteristic of JAN-6BG6G; Parametric in Ec 2

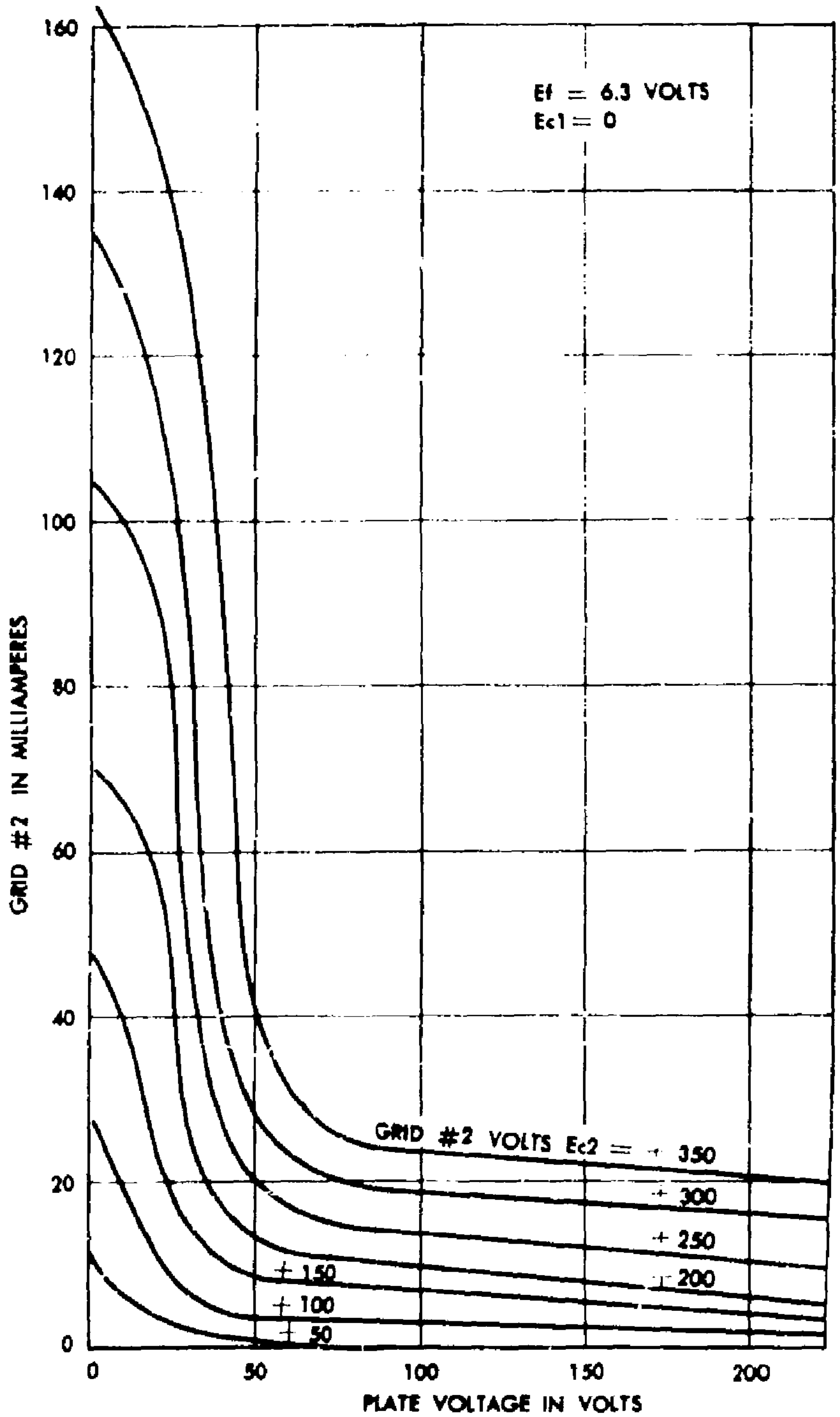


Figure 3-113. Typical Screen Grid Characteristic of JAN-6BG6G; Parametric in Ec 2

SECTION 22

TUBE TYPE JAN-6C4W

3.22. DESCRIPTION.

3.22.1 The JAN-6C4W 1/ is a seven pin miniature triode with a mu in the Range 15.5 to 18.5 with a transconductance ranging from 1750 to 4400 depending upon choice of operating point.

3.22.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	6.3 V
Cathode	Coated Unipotential

3.22.3 MOUNTING. Not specified.

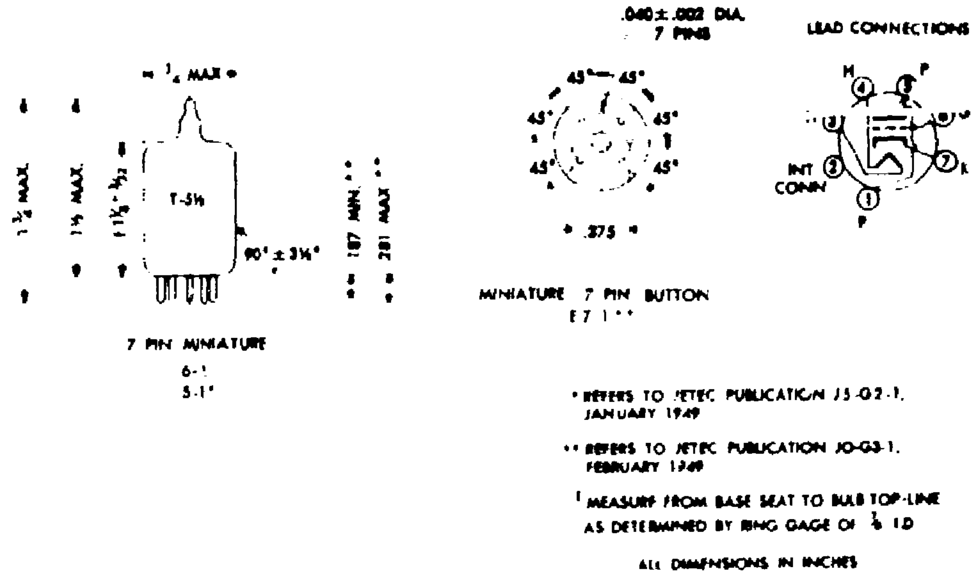


Figure 3-114. Outline Drawing and Base Diagram of Tube Type JAN-6C4W

3.22.4 RATINGS, ABSOLUTE SYSTEM.

3.22.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 10% V
Plate Voltage	330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Heater-Cathode Voltage	100 V
Plate Dissipation	3.8 W
* Altitude Rating	10,000 ft

---

* No test at this rating exists in the Specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/55B dated 14 January 1954.

3.22.6 TEST CONDITIONS.

3.22.7 **Test conditions are as follows:**

Heater Voltage, Ef . . . . 6.3 V
Plate Voltage, Eb . . . . 250 Vdc
Grid Voltage, Ec . . . . -8.5 Vdc

3.22.8 ACCEPTANCE TEST LIMITS.

3.22.9 **The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/55B dated 14 January 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.**

TABLE 3-32. ACCEPTANCE TEST LIMITS OF JAN-6C4W

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		138	162	---	---	mA
Transconductance (1)	Sm		1750	2650	1430	---	umhos
Amplification Factor	Mu		15.5	18.5	---	---	
Plate Current (1)	Ib		6.5	14.5	---	---	mAdc
Plate Current (2)	Ib	Ec = -30 Vdc	---	50	---	---	uAdc
Emission	Is	Eb = Ec = 15 Vdc	30	---	---	---	mAdc
Power Output	Po	Eb = 300 Vdc Rg = 8500 F = 150 Mc	1.8	---	---	---	W
Capacitance (Without shield)	Cgp	Ef = 0	1.35	2.25	---	---	uuf
	Cin	Ef = 0	1.2	2.2	---	---	uuf
	Cout	Ef = 0	0.8	1.4	---	---	uuf
Grid Current	Ic		0	-1.5	---	-2.0	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	0	20	---	---	uAdc
	Ihk	Ehk = -100 Vdc	0	-20	---	---	uAdc

3.22.10 Table 3-33 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

3.22.11 APPLICATION.

3.22.12 Figure 3-115 below shows the permissible operating area for JAN-6C4W as defined by the ratings in MIL-E-1/55B dated 14 January 1954. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2 through 3.1.6.

TABLE 3-33. APPLICATION PRECAUTIONS FOR JAN-6C4W

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
High, 3.1.8
Low, 3.1.15
AC Operation, 1.3.20, 3.1.10
28 Volt, 3.1.15
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.1.3
Cathode, 2.1.3, 3.1.12
Fixed, 1.3.8, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.[illegible], 3.1.3
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

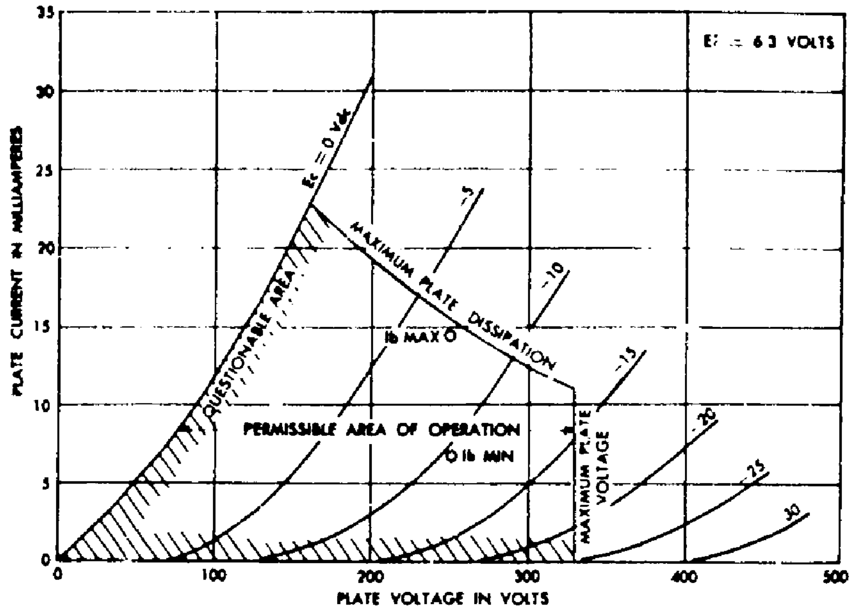


Figure 3-115. Typical Plate Characteristics of JAN-6C4W; Permissible Area of Operation

3.22.13 VARIABILITY OF CHARACTERISTICS.

3.22.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.22.15 The charts below present the limit behavior of static and transfer plate characteristics for JAN-6C4W as defined by MIL-E-1/55B dated 14 January 1954.

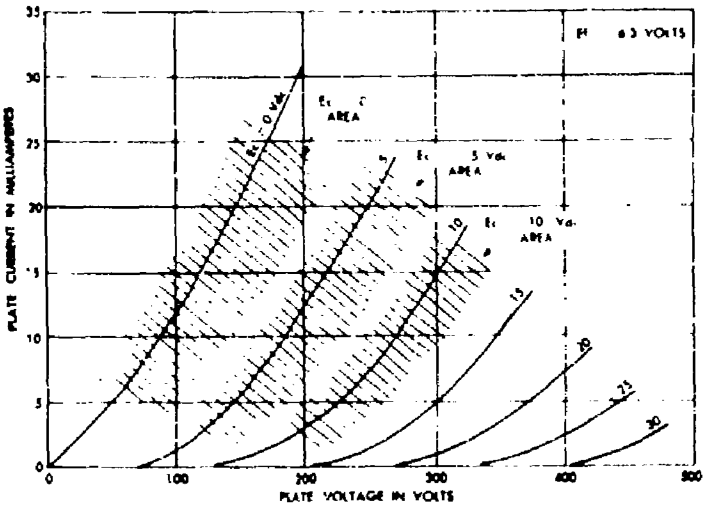


Figure 3-116. Limit Plate Characteristics of JAN-6C4W

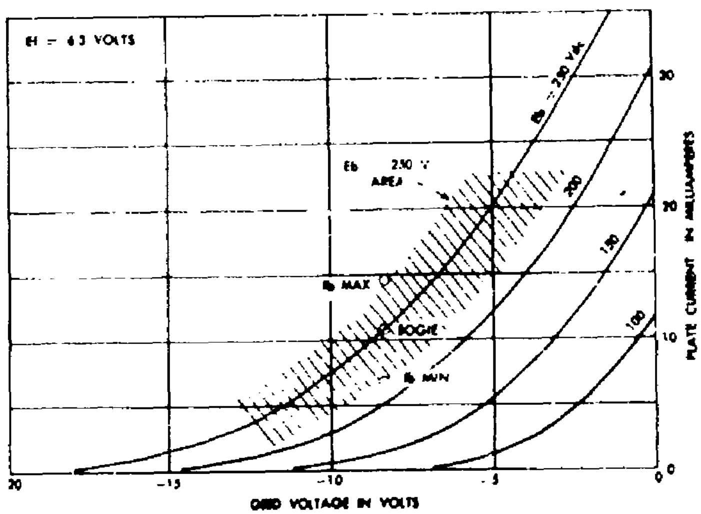


Figure 3-117. Limit Transfer Characteristics of JAN-6C4W

3.22.16 DESIGN CENTER CHARACTERISTICS.

3.22.17 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.22.18 The charts below present the average Static and transfer Plate Characteristics of JAN-6C4W.

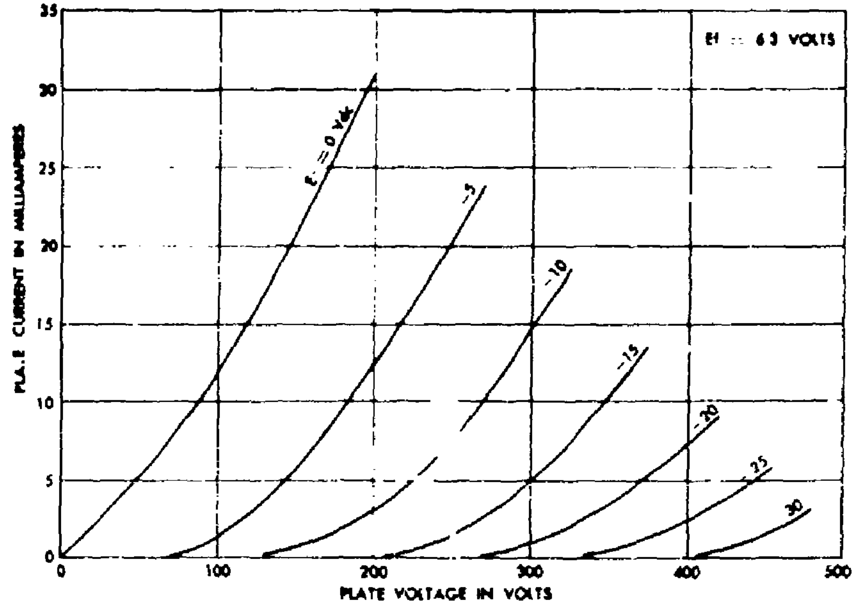


Figure 3-118. Typical Plate Characteristics of JAN-6C4W

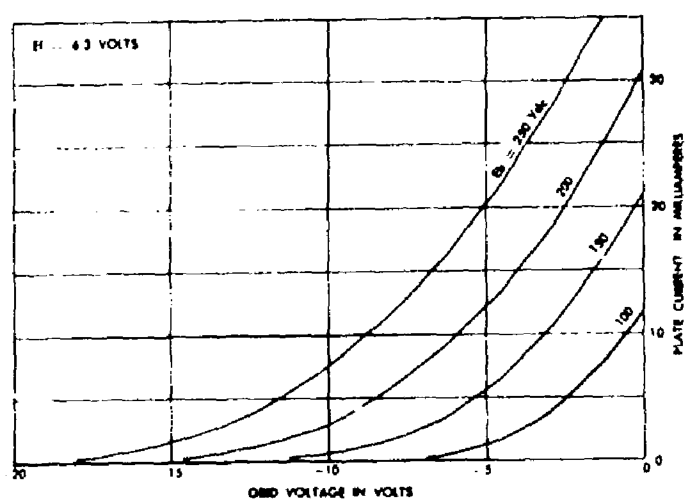


Figure 3-119. Typical Transfer Characteristics of JAN-6C4W

SECTION 23

TUBE TYPE JAN-6L6WGB

3.23. DESCRIPTION.

3.23.1 The JAN-6L6WGB 1/ is a 7 pin octal base, glass envelope, beam power-pentode.

3.23.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage, AC or DC	6.3 V
Heater Current	840 to 960 mA
** Cathode	Coated Unipotential

3.23.3 MOUNTING. Not specified.

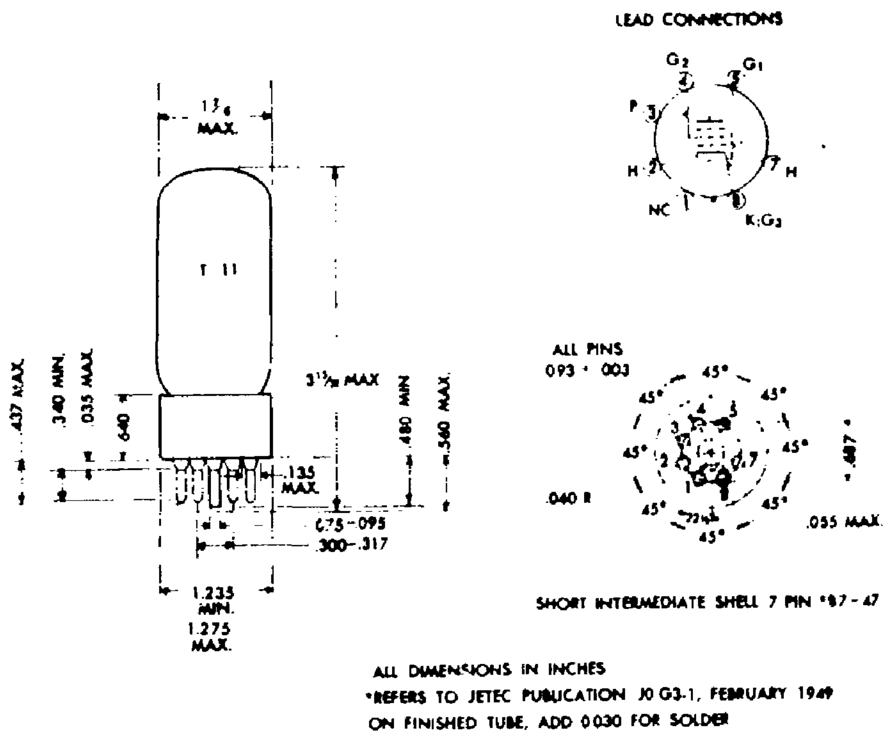


Figure 3-120. Outline Drawing and Base Diagram of Tube Type JAN-6L6WGB

3.23.4 RATINGS, ABSOLUTE SYSTEM.

3.23.5 The absolute systems ratings are as follows:

Heater Voltage	6.3 ± 10% V
Plate Voltage	400 Vdc

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

1/ The values and specification comments presented in this section are related to MIL-E-1/197 dated 20 May 1953

Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Screen Grid Voltage. . . . . 300 Vdc
Plate Dissipation . . . . 26 W
* Screen Grid Dissipation . . . . 3.5 W
Altitude . . . . 10,000 ft

3.23.6 TEST CONDITIONS.

3.23.7 Test conditions are as follows:
Heater Voltage, Ef . . . . 6.3 V
Plate Voltage, Eb . . . . 250 Vdc
Control Grid Voltage, Ec1 . . . . -14 Vdc
Screen Grid Voltage, Ec2 . . . . 250 Vdc

3.23.8 ACCEPTANCE TEST LIMITS.

3.23.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/197 dated 20 May 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.23.10 APPLICATION.

3.23.11 Figure 3-121 below shows the permissible operating area for JAN-6L6WGB as defined by the ratings in MIL-E-1/197 dated 20 May 1953. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2 through 3.2.7.

* No test of operation at this rating exists in the specification.

TABLE 3-34. ACCEPTANCE TEST LIMITS OF JAN-6L6WGB

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		840	960	---	---	mA
Transconductance	Sm		5200	6800	4500	---	umhos
Plate Current	Ib	Eb = 400 Vdc; Ec2 = 300 Vdc; Ec1 = -22 Vdc	50	80	---	---	mAdc
Emission	Is	Eb = Ec1 = Ec2 = 50 Vdc	275	---	---	---	mAdc
Screen Grid Current	Ic2	Eb = 400 Vdc; Ec2 = 300 Vdc; Ec1 = -22 Vdc;	0	5.0	---	---	mAdc
Power Output	Po	Esig = 9.8 Vac; Rp = 2500 ohms	5.4	---	4.0	---	W
Grid Current	Ic1	Eb = 400 Vdc; Ec2 = 300 Vdc; Ec1 = -19 Vdc	0	-3.0	---	---	uAdc
Heater-Cathode Leakage	Ihk Ihk	Ehk = +100 Vdc Ehk = -100 Vdc	0	75	---	---	uAdc

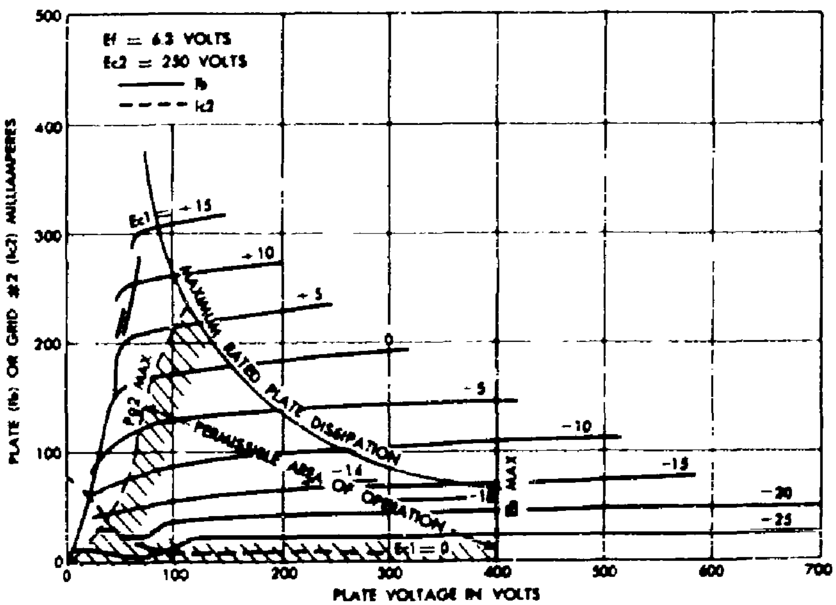


Figure 3-121. Typical Plate Characteristics of JAN-6L6WGB; Permissible Area of Operation Ec2 = 250

TABLE 3-35. APPLICATION PRECAUTIONS OF JAN-6L6WGB

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation 1.3.20 3.2.18
Screen Grid:
Supply 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Therminonic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1., 3.2 3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.23.13 VARIABILITY OF CHARACTERISTICS.

3.23.14 The published data that describe and define JAN-6L6WGB are predicated on a design center screen voltage of 250 Vdc.

3.23.15 The specification, MIL-E-1/197, dated 20 May 1953 defines the operation of this type at a screen grid voltage of 300 Vdc.

3.23.16 The manufacturer of this type made available a quantity of design center tubes, and from these, certain inferences concerning the behavior of JAN-6L6WGB at a screen grid voltage of 300 Vdc were made.

3.23.17 The limit curves, Figures 3-122 and 3-123 were therefore drawn on the averaged static plate and transfer curves prepared from these design center tubes. The limits and boundaries were determined from the acceptance limits given on the specification.

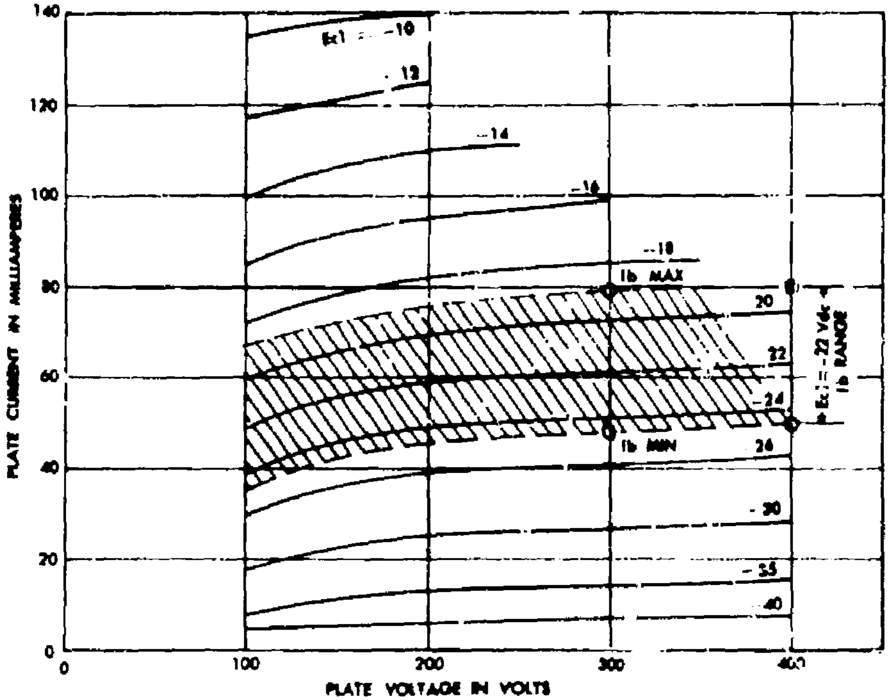


Figure 3-122. Limit Plate Characteristics of JAN-6L6WGB; Ec2 = 300

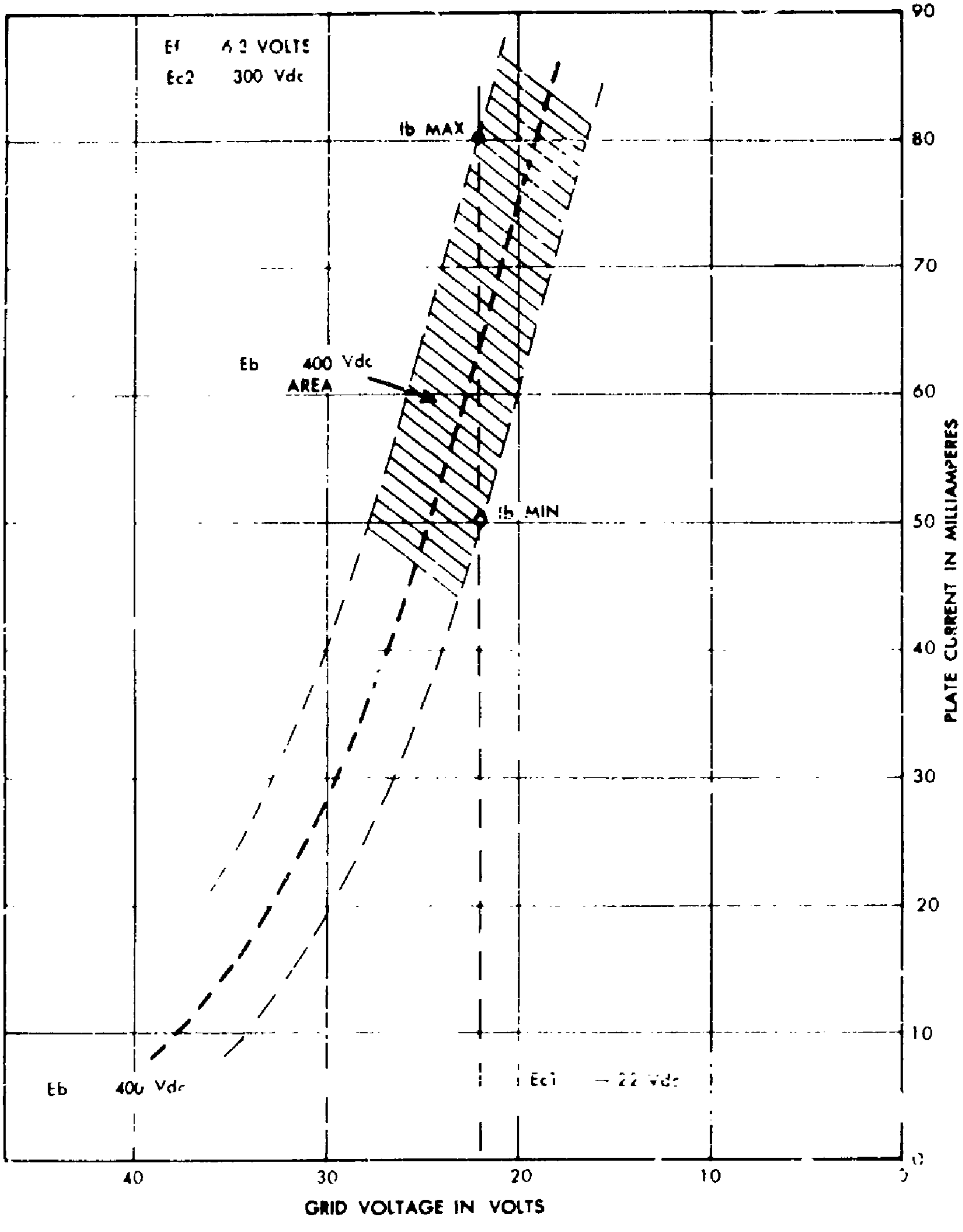


Figure 3-123. Limit Transfer Characteristics of JAN-6L6WGB; Ec2 = 300

3.23.18 DESIGN CENTER CHARACTERISTICS.

3.23.19 Figures 3-124 and 3-125 are typical curves that have been obtained from current data being published bv the original RETMA registrant of this type.

3.23.20 Analysis of a quantity of near design center tubes has resulted in a set of averaged static plate characteristics for JAN-6L6WGB at the MIL-E-1 test voltages. From this data, an average static plate plot has been prepared for Figure 3-126 and the permissible operating region has been portrayed thereon in Figure 3-127.

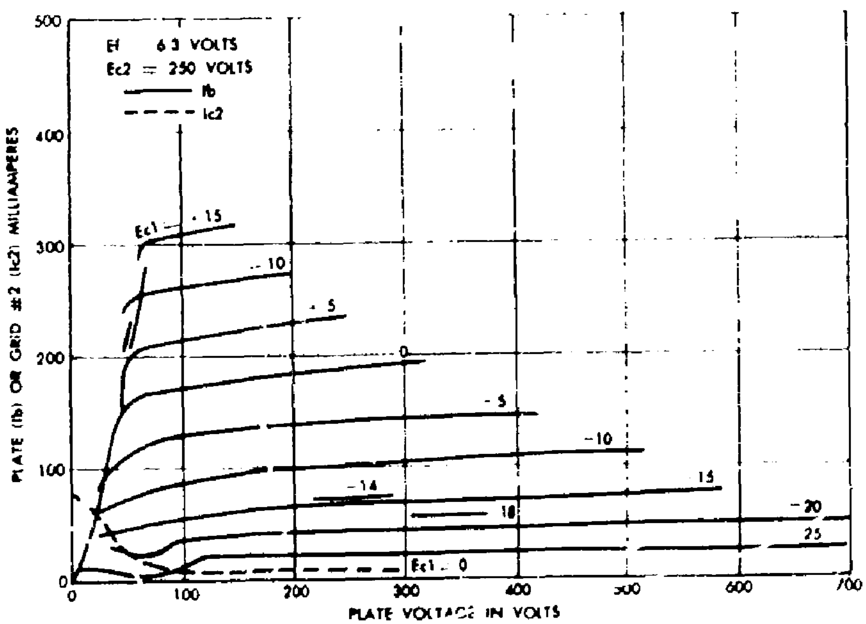


Figure 3-124. Typical Plate Characteristics of JAN-6L6WGB; Ec2 = 250

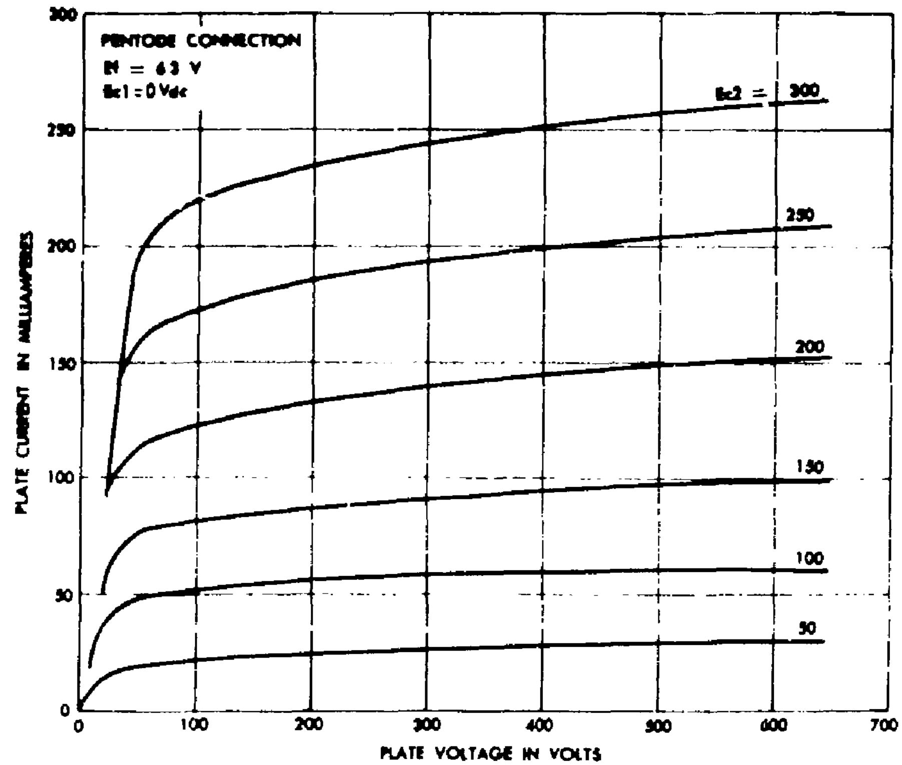


Figure 3-125. Typical Plate Characteristics of JAN-6L6WGB; Parametric Ec2

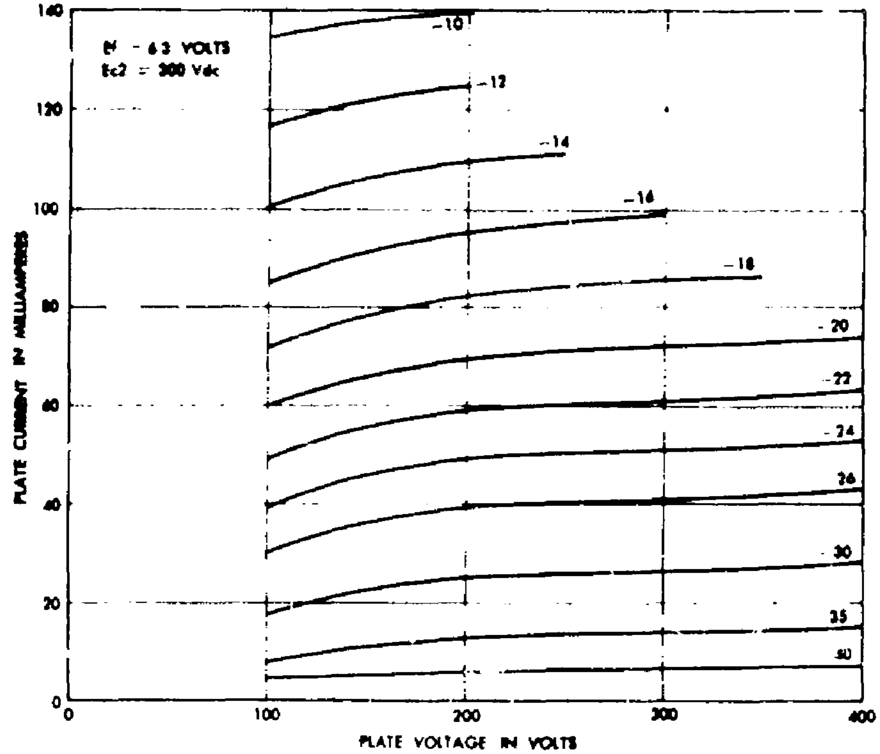


Figure 3-126. Typical Plate Characteristics of JAN-6L6WGB; Ec2 = 300

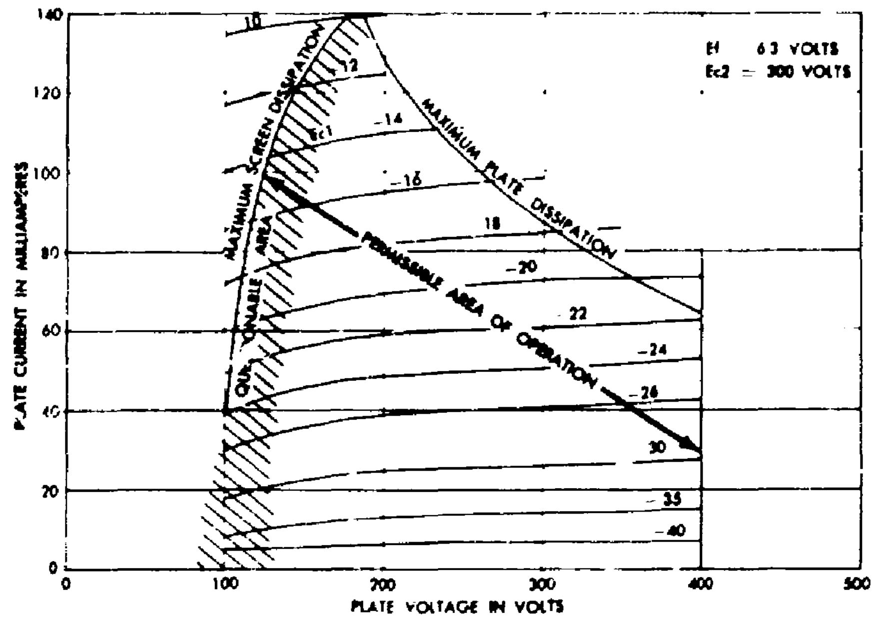


Figure 3-127. Permissible Operating Region of JAN-6L6WGB; Ec2 = 300

TUBE TYPE JAN-6X4W

3.24 DESCRIPTION.

3.24.1 The JAN-6X4W [1] is a miniature, heater-cathode type twin diode suitable for full-wave rectifier operation where the average d-c current is not in excess of 75 milliamperes.

3.24.2 **ELECTRICAL**. The electrical characteristics are as follows:

Heater Voltage	6.3 V
Cathode	Coated Unipotential

3.24.3 **MOUNTING**. Not specified.

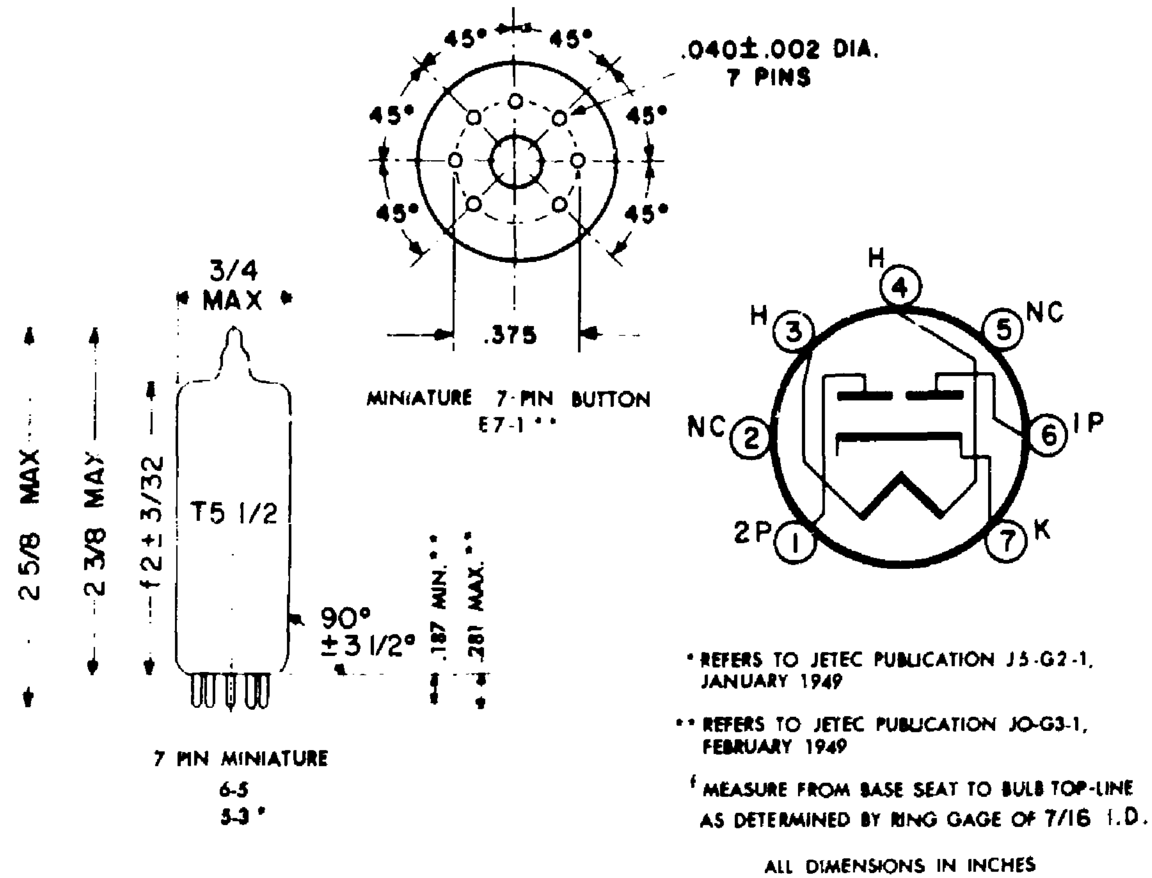


Figure 3-128. Outline Drawing and Base Diagram of Tube Type JAN-6X4W

1/ The values and specification comments presented in this section are related to MIL-E-1/64A dated 20 May 1953.

3.24.4 **RATINGS, ABSOLUTE MAXIMUM.**

3.24.5 The absolute maximum ratings are as follows:

- Heater Voltage .... 6.3V ± 10%
- Peak Inverse Plate Voltage .... 1375 v
- Steady State Peak Plate Current (each plate) .... 230 ma
- DC output current, both plates .... 75 mAdc
- *Transient Peak Plate Current, each plate .... 750 ma
- Heater Cathode Voltage .... 450 v
- *Altitude Rating .... 10,000 ft

3.24.6 **TEST CONDITIONS.**

3.24.7 Test conditions are as follows:

- Heater Voltage, Ef .... 6.3 V
- Secondary Voltage to Plate, Epp .... 400 Vac
- Load Resistance (RL) (unity power factor) ..... 5700 ohms
- Load Capacitor (CL) .... 8 uf

3.24.8 **ACCEPTANCE TEST LIMITS.**

3.24.9 The following table summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/64A dated 20 May 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

TABLE 3-36. ACCEPTANCE TEST LIMITS OF JAN-6X4W

PROPERTY		MEASURE-MENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		540	660	---	---	mA
Operation	Io	(Full-wave)	70	---	60	---	mA
Emission	Is	Eb = 50 Vdc (opposite plate grounded)	140	---	---	---	mA
Heater-Cathode Leakage	Ihk	Ehk=Eo	0	150	---	---	uAdc
	Ihk	Ehk=220 VRMS +100 Vdc	---	+150	---	---	uAdc

* No test at this rating exists in the specification.

3.24.10 APPLICATION.

3.24.11 RATING CHARTS.

3.24.12 Rating Charts I, II, and III represent areas of permissible operation within which any application of the JAN-6X4W must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.24.13 RATING CHART I. Rating Chart I(Figure 3-129)is based on maximum rated peak inverse voltage per plate (epx) of 1375 volts and maximum rated d-c output current per plate (Io/p) of 37.5 milliamperes. Point C corresponds to the simultaneous occurrence of these two ratings, permissible only under choke-input filter conditions. Point E is derived from life test conditions of rated d-c output current into capacitor-input filter. The area CDE is restricted to choke-input service only.

3.24.14 RATING CHART II. Rating Chart II(Figure 3-130), for capacitor-input filter applications, is based on maximum rated d-c output current per plate (Io/p) and maximum rated steady-state peak plate current of 230 milliamperes per plate. Rectification efficiency must not exceed 0.69 under conditions of maximum rated d-c output current. Rectification efficiency is equal to

$$\frac{Eo}{1.4\ Epp/p}$$

where Eo equals the d-c output voltage at the input filter in volts, and Epp/p equals the rms supply voltage per plate in volts.

3.24.15 RATING CHART III. Rating Chart III (Figure 3-131), for capacitor input filter application, is based on maximum rated surge current (i surge) of 750 milliamperes per plate. Minimum permissible series resistance (Rs) is approximately 750 ohms per plate under conditions of maximum permissible supply voltage.

3.24.16 OTHER CONSIDERATIONS.

3.24.17 HEATER VOLTAGE. Heater voltage considerations are discussed in paragraph 3.3.9.

3.24.18 ALTITUDE. Refer to paragraph 3.3.7 for a discussion of altitude considerations.

3.24.19 TYPICAL CHARACTERISTICS.

3.24.20 Figure 3-132 presents the static plate characteristic of JAN-6X4W reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification since a minimum limit only on emission is specified.

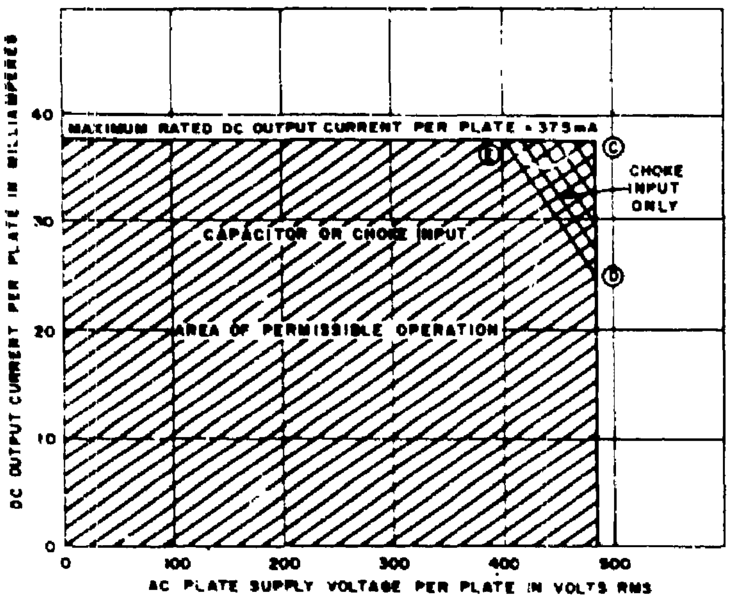


Figure 3-129. Rating Chart I for Tube Type JAN-6X4W

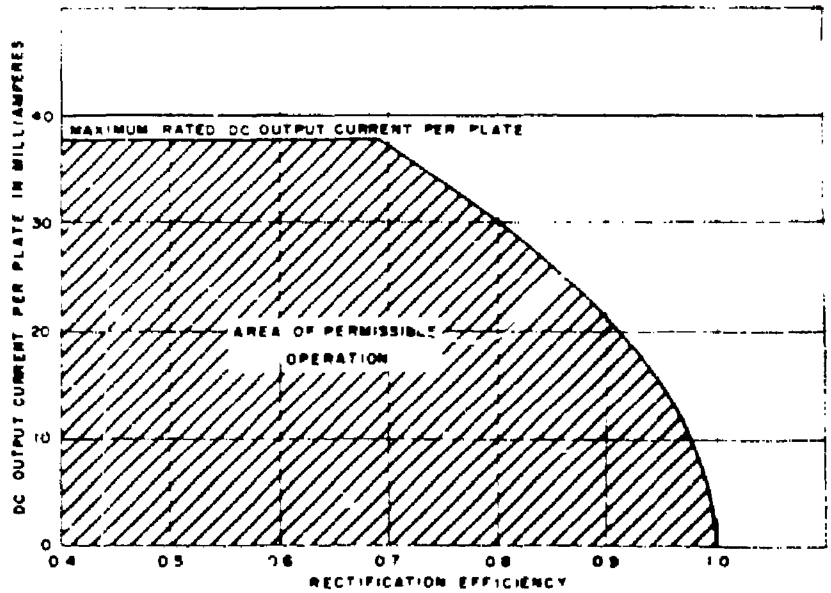


Figure 3-130. Rating Chart II for Tube Type JAN-6X4W

If Series Inductance is Present in the Plate Supply, Rs may be Less than Shown Provided i Surge does not exceed 750 MA.

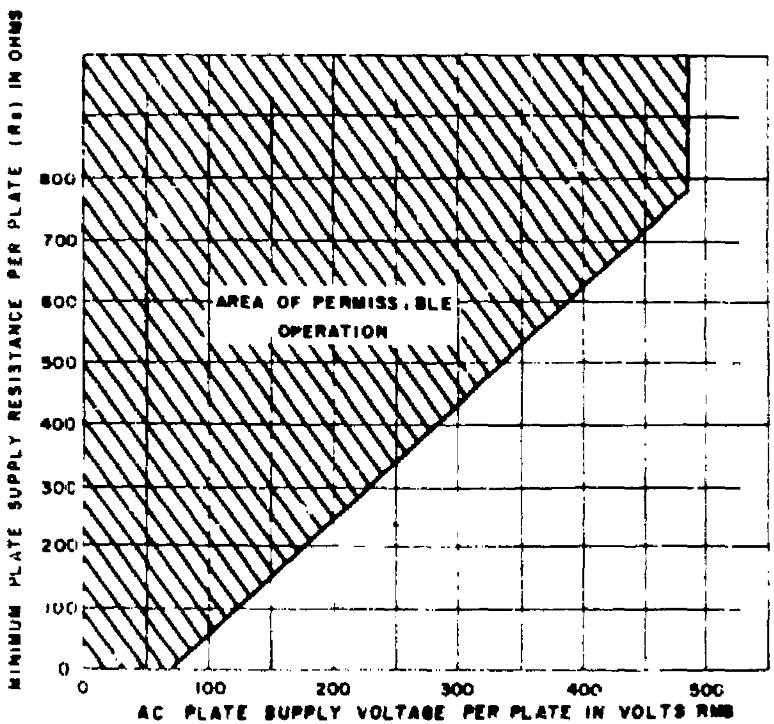


Figure 3-131. Rating Chart III for Tube Type JAN-6X4W Showing Minimum Allowable Resistance Effectively in Series with Each Plate of Rectifier Tube for any Allowable A-C Plate Voltage

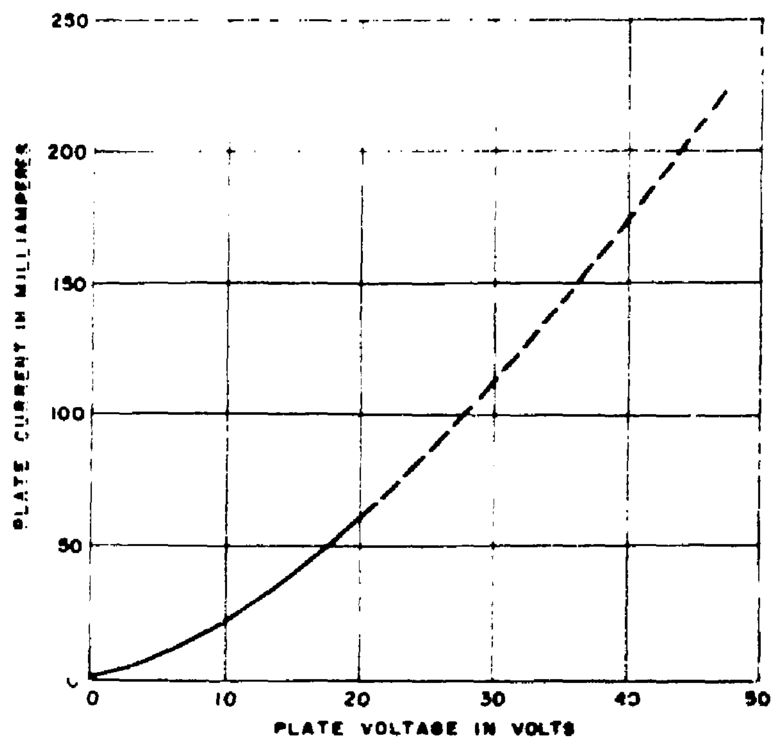


Figure 3-132. Typical Plate Characteristics for Tube Type JAN-6X4W

SECTION 25

TUBE TYPE JAN-12AT7WA

3.25 DESCRIPTION.

3.25.1 The JAN-12AT7WA 1/ is a 9 pin miniature high transconductance (5500 micromhos) twin triode. This tube was originally designed for use as a grounded-grid RF amplifier or as a mixer in commercial T.V. Circuitry. Its center tapped heater permits operation from either 6.3 or 12.6 V.

3.25.2 ELECTRICAL. The electrical characteristics are as follows:

	Series	Parallel
Heater Voltage (A-C or D-C)	12.6	6.3 V
Heater Current, Design Center..	150	---
Cathodes	Coated Unipotential	

3.25.3 MOUNTING. Not specified.

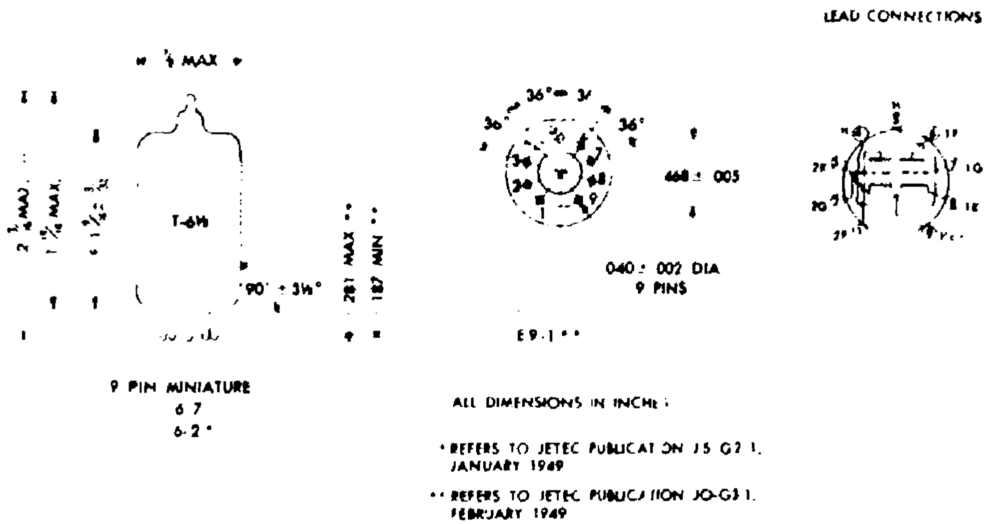


Figure 3-133. Outline Drawing and Base Diagram of Tube Type JAN-12AT7WA

1/ The values and specification comments presented in this section are related to MIL-E-1/3 dated 13 January 1953.

3.25.4 RATINGS, ABSOLUTE SYSTEM.

3.25.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 10% or 12.6 ± 10% V
Plate Voltage	330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
* Control Grid Voltage, Minimum	-55 Vdc
Plate Dissipation (per plate)	2.8 W
Heater-Cathode Voltage	± 100 V
* Bulb Temperature	200°C
Altitude Rating	10,000 ft

3.25.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.25.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	12.6 V
Plate Voltage, Eb	250 Vdc
Cathode Resistance, RK (per cathode)	200 ohms
Heater Current, If	150 mA
Plate Current, Ib	10 mA
Transconductance, Sm	5500 umhos

3.25.8 ACCEPTANCE TEST LIMITS.

3.25.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/3A dated 23 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics unless otherwise indicated.

* No test at this rating exists in the specification.

TABLE 3-37. ACCEPTANCE TEST LIMITS OF JAN-12AT7WA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		138	162	138	162	mA
Transconductance (1)	Sm		4500	6500	3800	6500	umhos
Change in average	$Avg \Delta \frac{Sm}{t}$		---	---	---	20	%
Amplification Factor	Mu		50	70	---	---	
Plate Current (1)	Ib		7.0	14.0	---	---	mAdc
Difference between sections	Ib		---	3.2	---	---	mAdc
Plate Current (2)	Ib	Ecl = -20 Vdc Rp = 0.1 Meg Rk = 0; Ck = 0;	---	100	---	---	uAdc
Capacitance (Unshielded)	Cgp	Ef = 0	1.30	1.90	---	---	uuf
	Cin	Ef = 0	2.00	3.00	---	---	uuf
	Cout-1	Ef = 0	0.20	0.70	---	---	uuf
	Cout-2	Ef = 0	0.16	0.60	---	---	uuf
	Cpp	Ef = 0	0.15	0.33	---	---	uuf
	Chk	Ef = 0	2.10	3.50	---	---	uuf
Grid Current	Ic	Rg = 0.5 Meg	---	-0.7	---	-0.7	uAdc
Heater-Cathode Leakage	Ihk	Ehk = 100 Vdc	---	10	---	10	uAdc
	Ihk	Ehk = -100 Vdc Units tied together	---	-10	---	-10	uAdc
Insulation of Electrodes	Rg-all	Rg-all = -100 Vdc	100	---	50	---	Meg
	Rp-all	Ep-all = -300 Vdc Ef = 12.6 V	100	---	50	---	Meg

3.25.10 APPLICATION.

3.25.11 The chart below shows the permissible operating area for JAN-12AT7WA as defined by the ratings in MIL-E-1/3 dated 13 January 1953. A discussion of the permissible operating area for triodes may be found in paragraphs 3.1.2 through 3.1.6.

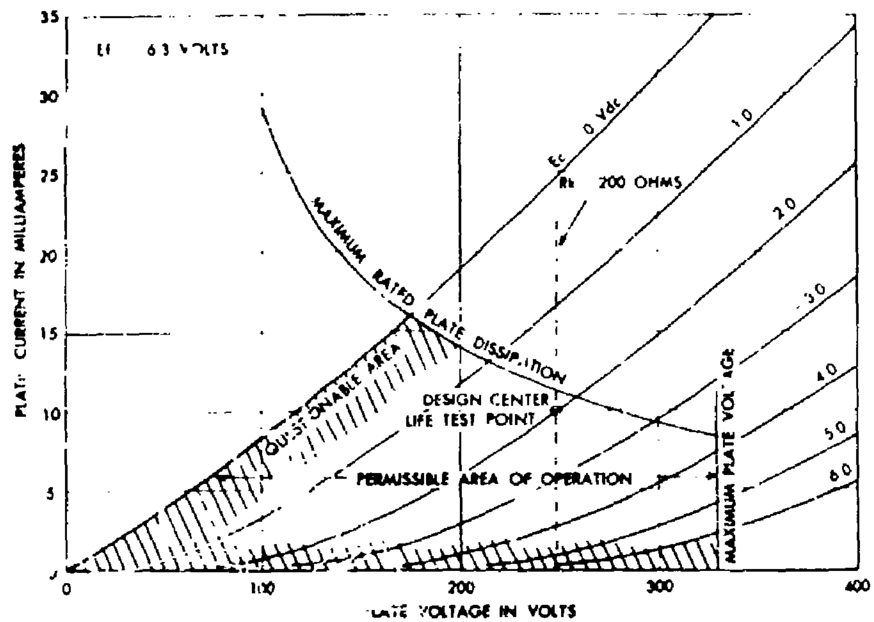


Figure 3-134. Typical Plate Characteristics of JAN-12AT7WA; Permissible Area of Operation

3.25.12 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-38. APPLICATION PRECAUTIONS FOR JAN-12AT7WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
 High, 3.1.8
 Low, 3.1.15
 AC Operation, 1.3.20, 3.1.10
 28 Volt, 3.1.15
Control Grid Bias:
 Low, 1.3.4, 1.3.9, 3.1.3
 Cathode, 2.1.3, 3.1.12
 Fixed, 1.3.8, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14

Current (Cont.)

Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

Temperature

Bulb and Environmental, 3.1.5

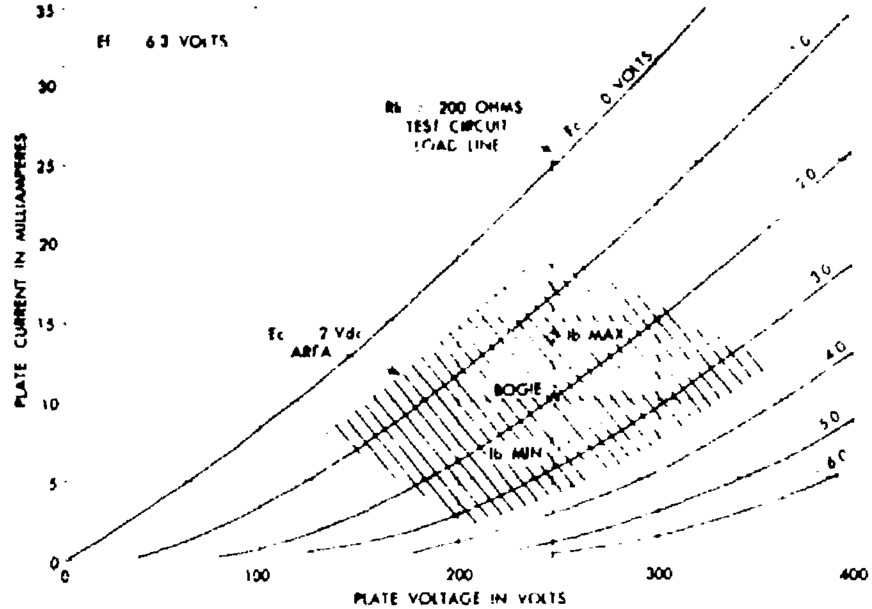
Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.25.13 VARIABILITY OF CHARACTERISTICS.

3.25.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.25.15 The chart below presents the limit behavior of static plate characteristics for JAN-12AT7WA as defined by MIL-E-1/3 dated 13 January 1953.



Note: These specification limit values are initial, not life test end point values.

Figure 3-135. Limit Plate Characteristics of JAN-12AT7WA

3.25.16 The chart below presents the limit behavior of transfer data for JAN-12AT7WA as defined by MIL-E-1/3 dated 13 January 1953.

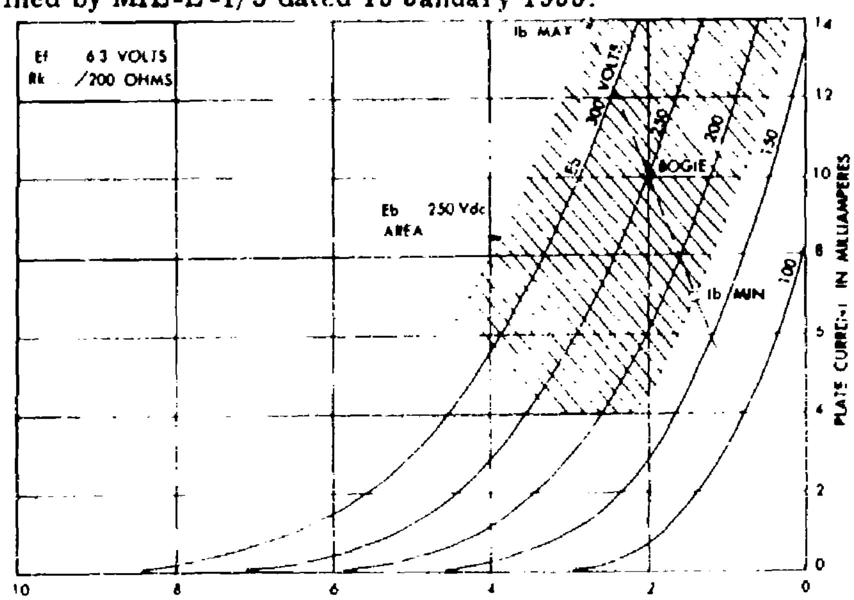


Figure 3-136. Limit Transfer Characteristics of Tube Type JAN-12AT7WA

3.25.17 DESIGN CENTER CHARAC?ERISTICS.

3.25.18 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.25.19 Figure 3-137 below presents the typical Static Plate Characteristics of JAN-12AT7WA.

3.25.20 Figure 3-138 represents typical transfer characteristics of this type.

3.25.21 Figure 3-139 affords a typical picture of the behavior of this tube in the positive grid region, although no MIL-E-1 testing is performed there.

3.25.22 Figure 3-140 is a plot of the typical behavior of the characteristics Mu, Sm, and Rp as functions of plate current Ib.

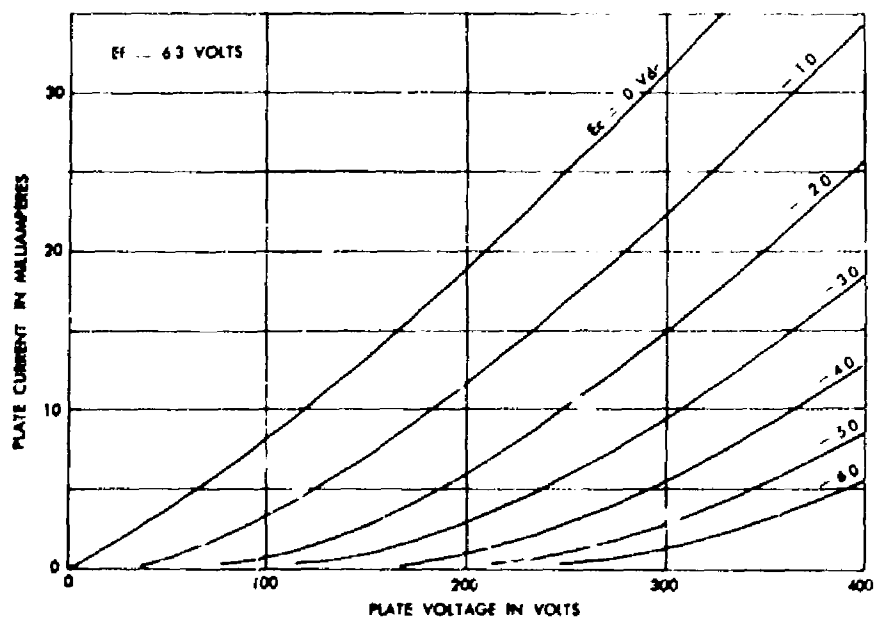


Figure 3-137. Typical Plate Characteristics of JAN-12AT7WA

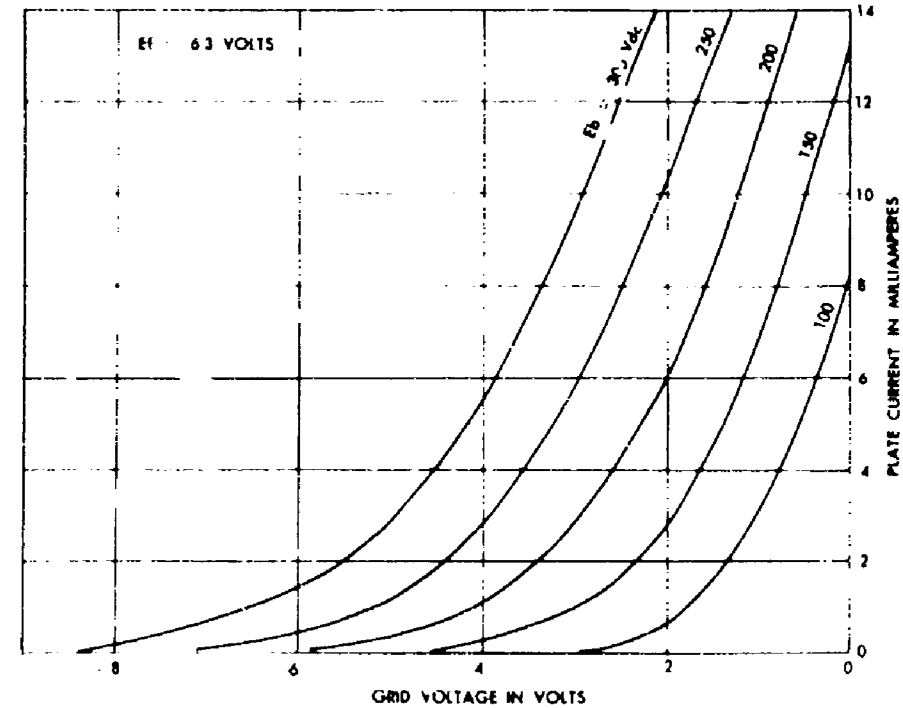


Figure 3-138. Typical Transfer Characteristics of JAN-12AT7WA

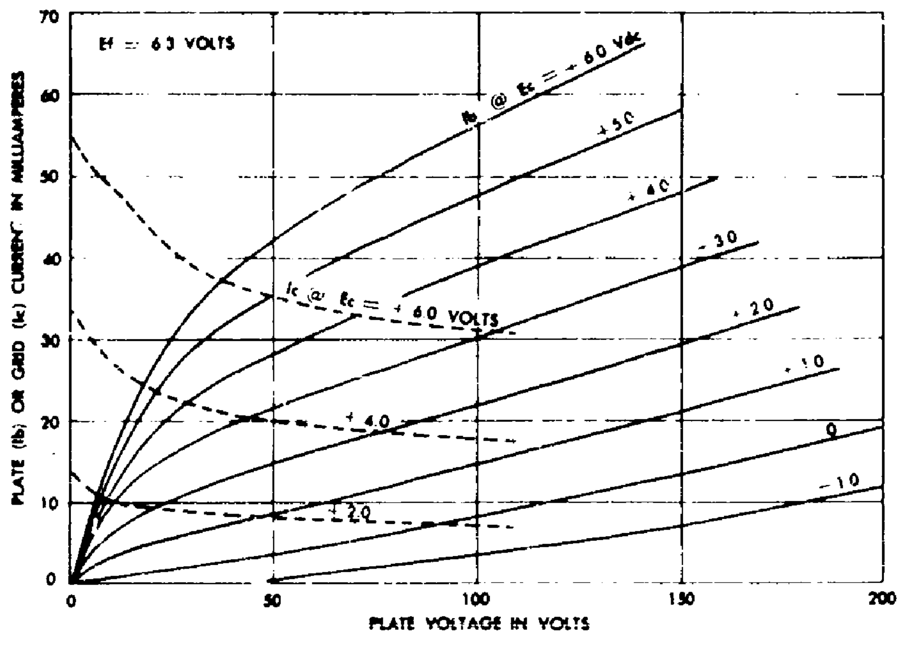


Figure 3-139. Typical Plate and Grid Characteristics of JAN-12AT7WA

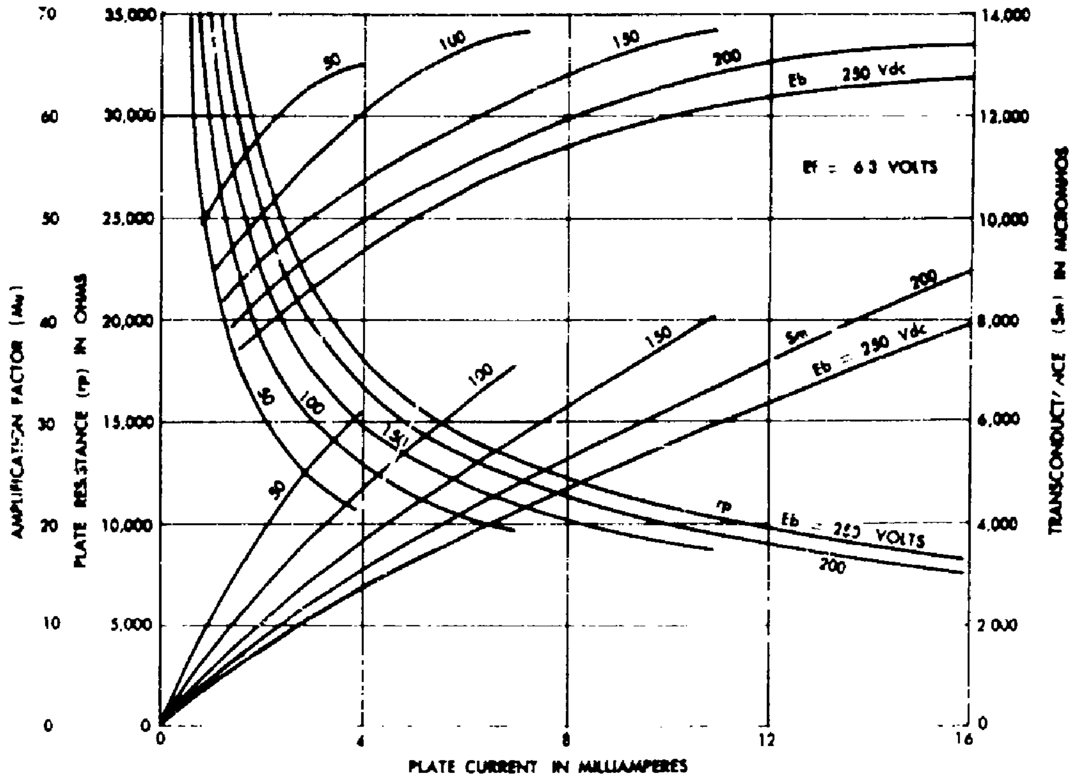


Figure 3-140. Typical Sm, Mu, rp Behavior of JAN-12AT7WA

TUBE TYPE JAN-5636

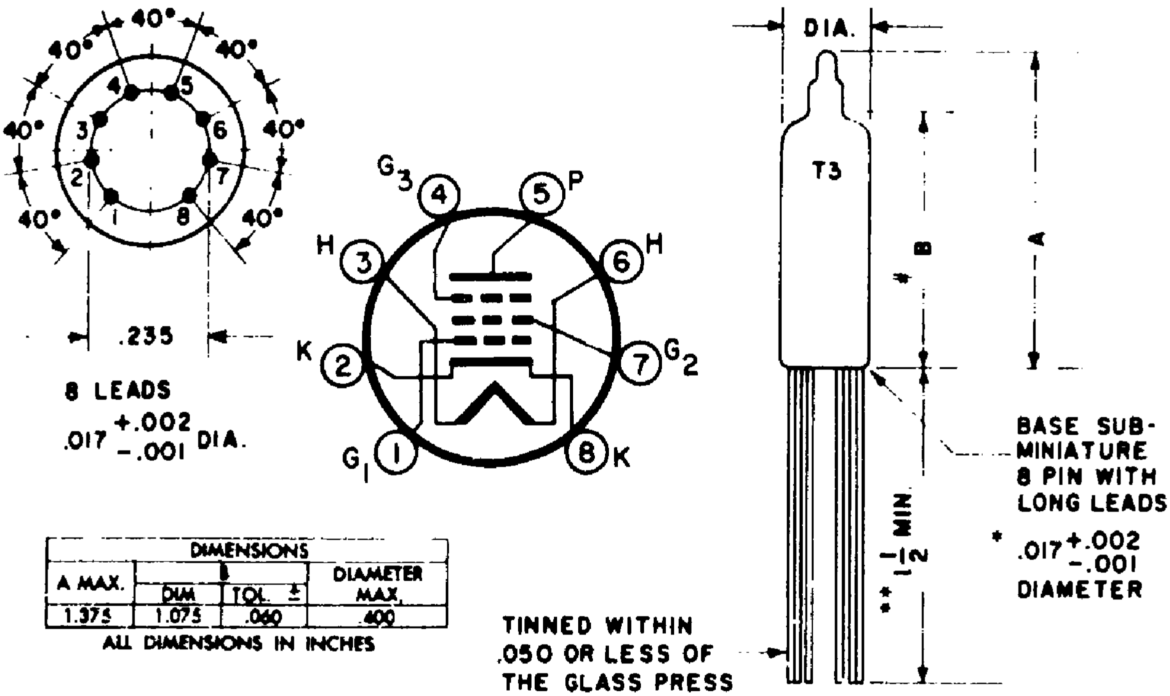
3.26 DESCRIPTION.

3.26.1 **The JAN-5636** [1/] **is an 8-lead, button-base, subminiature, dual-control pentode having a design center transconductance of 3200 micromhos. The JAN-5636 is similar in plate characteristics to JAN-5784WA and JAN-5725/6AS6W.**

3.26.2 **ELECTRICAL. The electrical characteristics are as follows:**

- **Heater Voltage** .... 6.3 V
- **Heater Current, Design Center** .... 150 mA
- **Cathode** .... Coated Unipotential

3.26.3 **MOUNTING.** Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX.
	DIM	TOL. ±	
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-141. Outline Drawing and Base Diagram of Tube Type JAN-5636

1/ The values and specification comments presented in this section are related to MIL-E-1/168C dated 23 June 1955.

3.26.4 RATINGS, ABSOLUTE SYSTEM.

3.26.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± .3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
First Control Grid Voltage, Maximum	0 Vdc
First Control Grid Voltage, Minimum	-55 Vdc
*Screen Grid Voltage	155 Vdc
First Suppressor Grid Voltage	30 Vdc
First Heater-Cathode Voltage	200 v
Control Grid Series Resistance	1.1 Meg
**Cathode Current, Maximum	16.0 mAdc
Plate Dissipation	0.55 W
*Screen Grid Dissipation	0.45 W
Bulb Temperature	+220° C
Altitude Rating	60,000 ft

3.26.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.26.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Screen Grid Voltage, Ec2	100 Vdc
Suppressor Grid Voltage, Ec3	0 Vdc
Cathode Resistance, Rk	150 ohms
Heater Current, If	150 mA
Plate Current, Ib	5.3 mAdc
Transconductance, Sm	3200 umhos

3.26.8 ACCEPTANCE TEST LIMITS.

3.26.9 Table 3-39 summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/168C dated 23 June 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-39. ACCEPTANCE TEST LIMITS OF JAN-5636

PROPERTY	MEASUREMENT CONDITIONS	LIMITS				UNITS
		INITIAL		LIFE TEST		
		MIN	MAX	MIN	MAX	
Heater Current If		140	160	138	164	mA
Transconductance (1) Sm		2700	4000	---	---	umhos
Change in individuals Δ Sm t		---	---	---	20	%
Plate Current (1) Ib		3.7	6.9	---	---	mAdc
Plate Current (3) Ib	Ec3 = -8.0 Vdc	---	100	---	---	uAdc
Screen Grid Current Ic2		2.8	5.4	---	---	mAdc
Capacitance Cg1-p	Ef = 0	---	0.015	---	---	uuf
Cg3-p	Ef = 0	---	1.10	---	---	uuf
(Shielded as specified)						
Cg1-g3	Ef = 0	---	0.15	---	---	uuf
Cg1-all	Ef = 0	3.5	4.5	---	---	uuf
Cg3-all	Ef = 0	3.5	4.5	---	---	uuf
Cp-all	Ef = 0	2.9	3.9	---	---	uuf
Control Grid Current Ic1	Rg1 = 1.0 Meg	0	-0.3	0	-0.9	uAdc
Heater-Cathode Leakage						
Ihk	Ehk= +100 Vdc	---	5.0	---	10.0	uAdc
Ihk	Ehk= -100 Vdc	---	-5.0	---	-10.0	uAdc
Insulation of Electrodes						
R(g1-all)	Eg1-all = -100 Vdc	100	---	50	---	Meg
R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

3.26.10 APPLICATION.

3.26.11 Figure 3-142 shows the permissible operating area for JAN-5636 as defined by the ratings in MIL-E-1/168C dated 23 June 1955. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.26.12 Table 3-40 lists general considerations for the applications of this tube type. The numbers refer to the applicable paragraphs of this Manual.

TABLE 3-40. APPLICATION PRECAUTIONS FOR JAN-5636

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.27, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
  High, 3.2.12
  Low, 3.2.3, 3.2.7
  28 Volt, 3.2.21
  AC Operation, 1.3.20, 3.2.18
Screen Grid:
  Supply, 3.2.8
  Protection, 3.2.22
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
  Cathode, 3.2.15
  Fixed, 1.3.8, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.26.13 VARIABILITY OF CHARACTERISTICS.

3.26.14 The following charts show the amount of variation which may be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.26.15 Figure 3-143 presents the limit behavior of static plate characteristics for JAN-5636 as defined by MIL-E-1/168C dated 23 June 1955.

3.26.16 Figure 3-144 presents the limit behavior of transfer data for JAN-5636 as defined by MIL-E-1/168C dated 23 June 1955.

3.26.17 DESIGN CENTER CHARACTERISTICS.

3.26.18 These typical curves have been obtained from data published by the original RETMA registrant of this type.

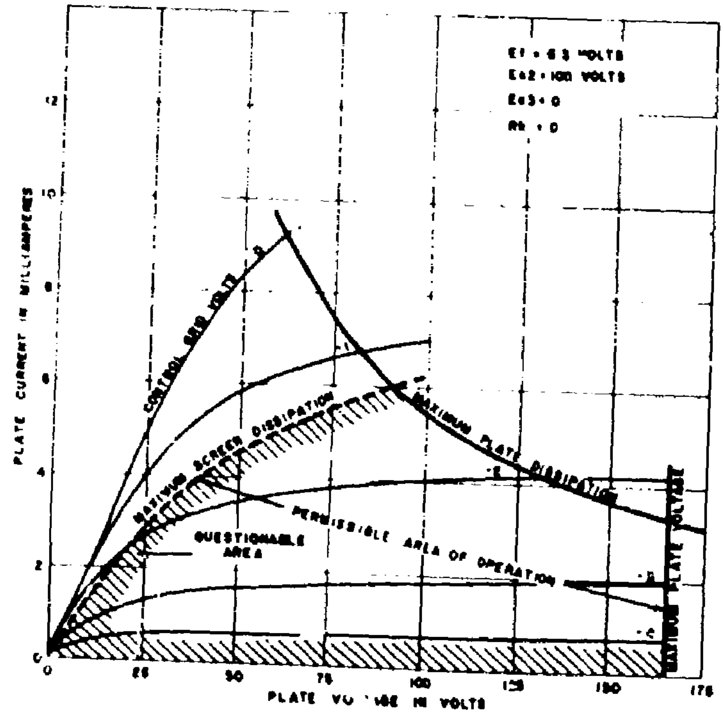


Figure 3-142. **Typical Plate Characteristics of Tube Type JAN-5636 with Permissible Area of Operation**

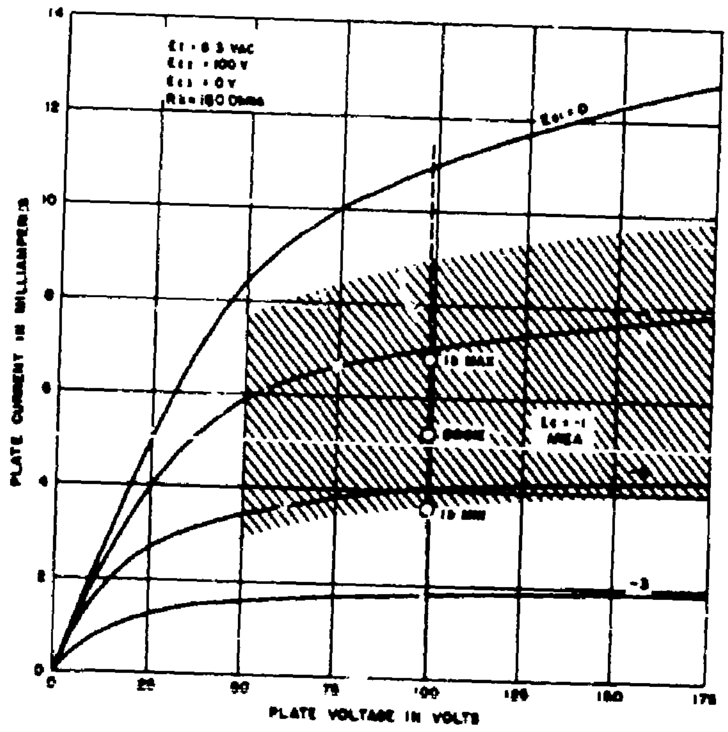


Figure 3-143. **Limit Behavior of JAN-5636 Static-Plate Data; Variability of Ib**

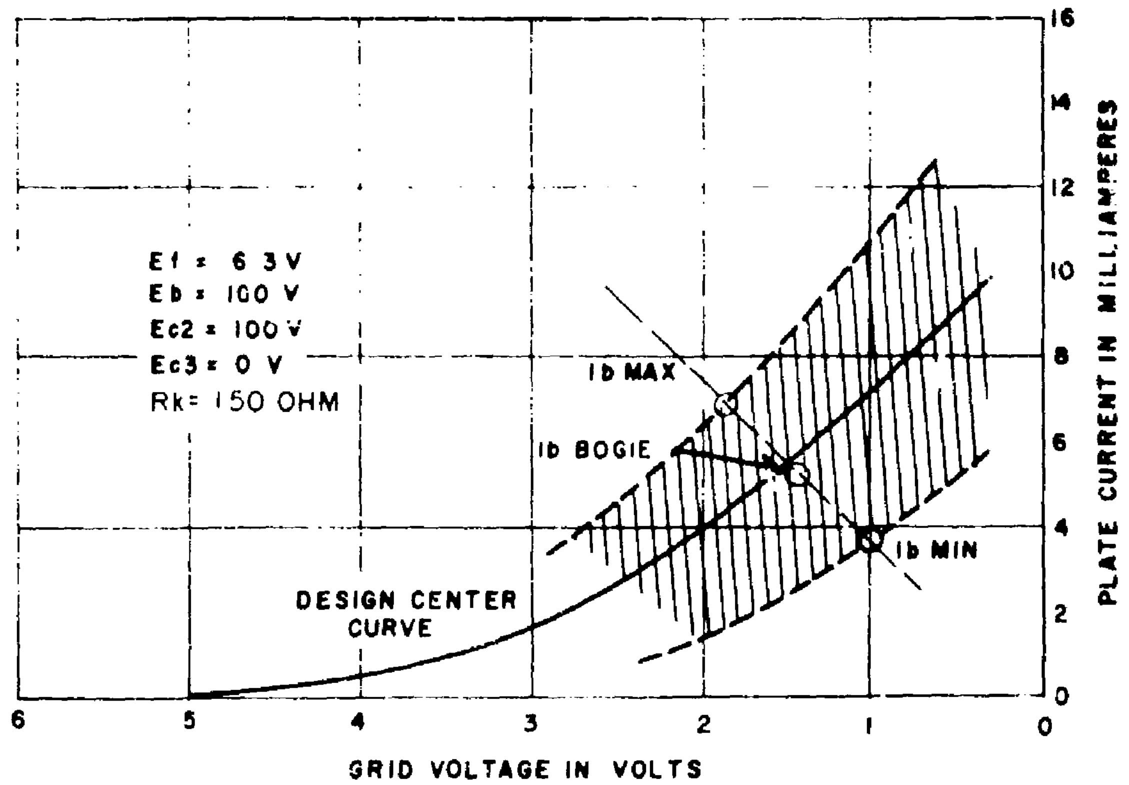


Figure 3-144. Limit Behavior of Transfer Data for Tube Type JAN-5636

3.8.19 Figure 3-145 presents the static plate characteristics of JAN-5636.

3.8.20 Figure 3-146 presents the typical transfer data for JAN-5636.

3.8.21 Figure 3-147 presents the typical transconductance characteristics of JAN-5636; grid No. 1 to plate.

3.8.22 Figure 3-148 presents the typical transconductance characteristics of JAN-5636; grid No. 3 to plate.

3.8.23 Figure 3-149 presents the typical conversion characteristics, control grid voltage of JAN-5636.

3.8.24 Figure 3-150 presents the typical conversion characteristics, oscillator injection voltage of JAN-5636.

3.8.25 Figure 3-151 presents the typical plate suppressor grid characteristics of JAN-5636.

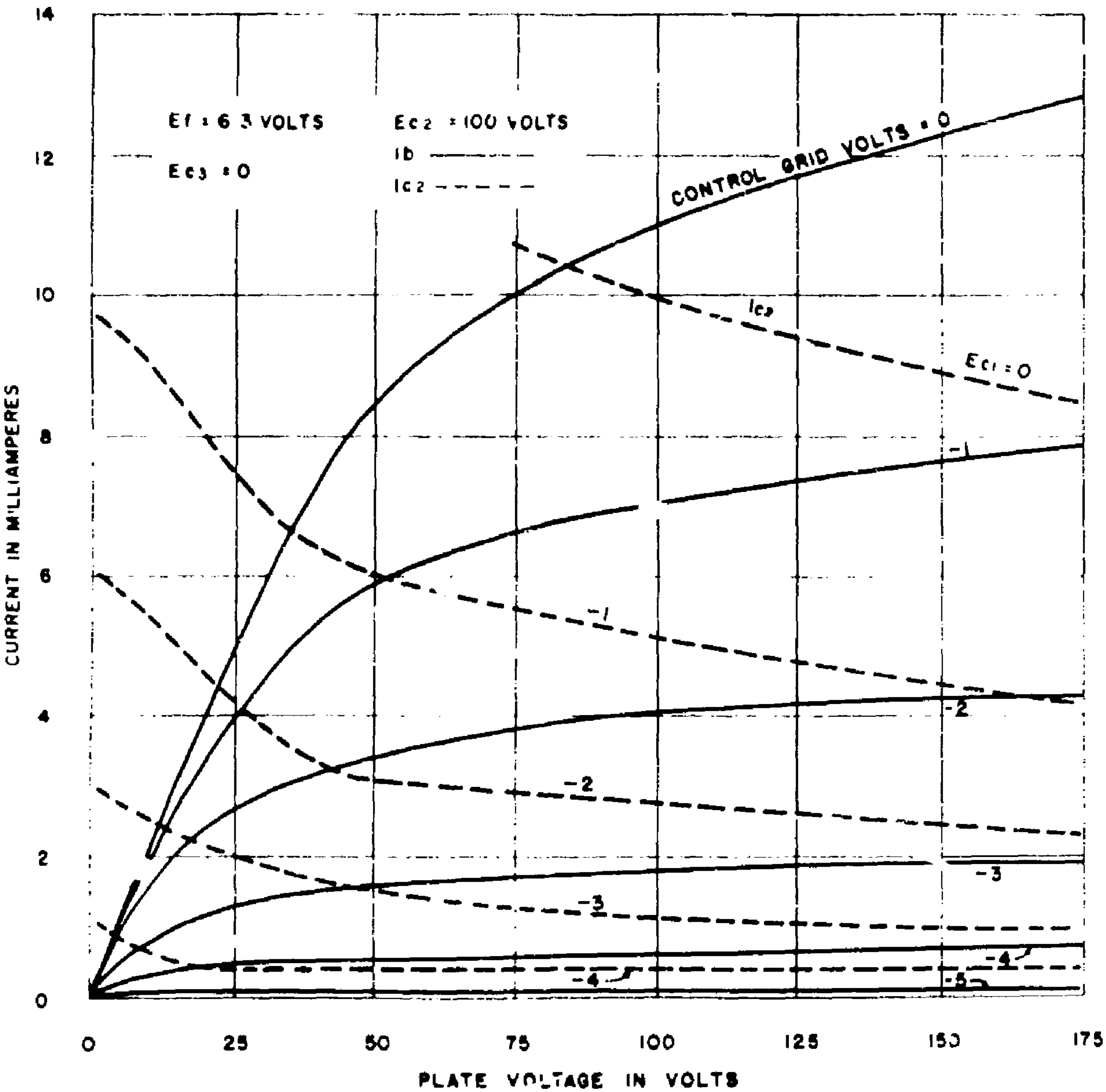


Figure 3-145. **Typical Plate Characteristics of JAN-5636**

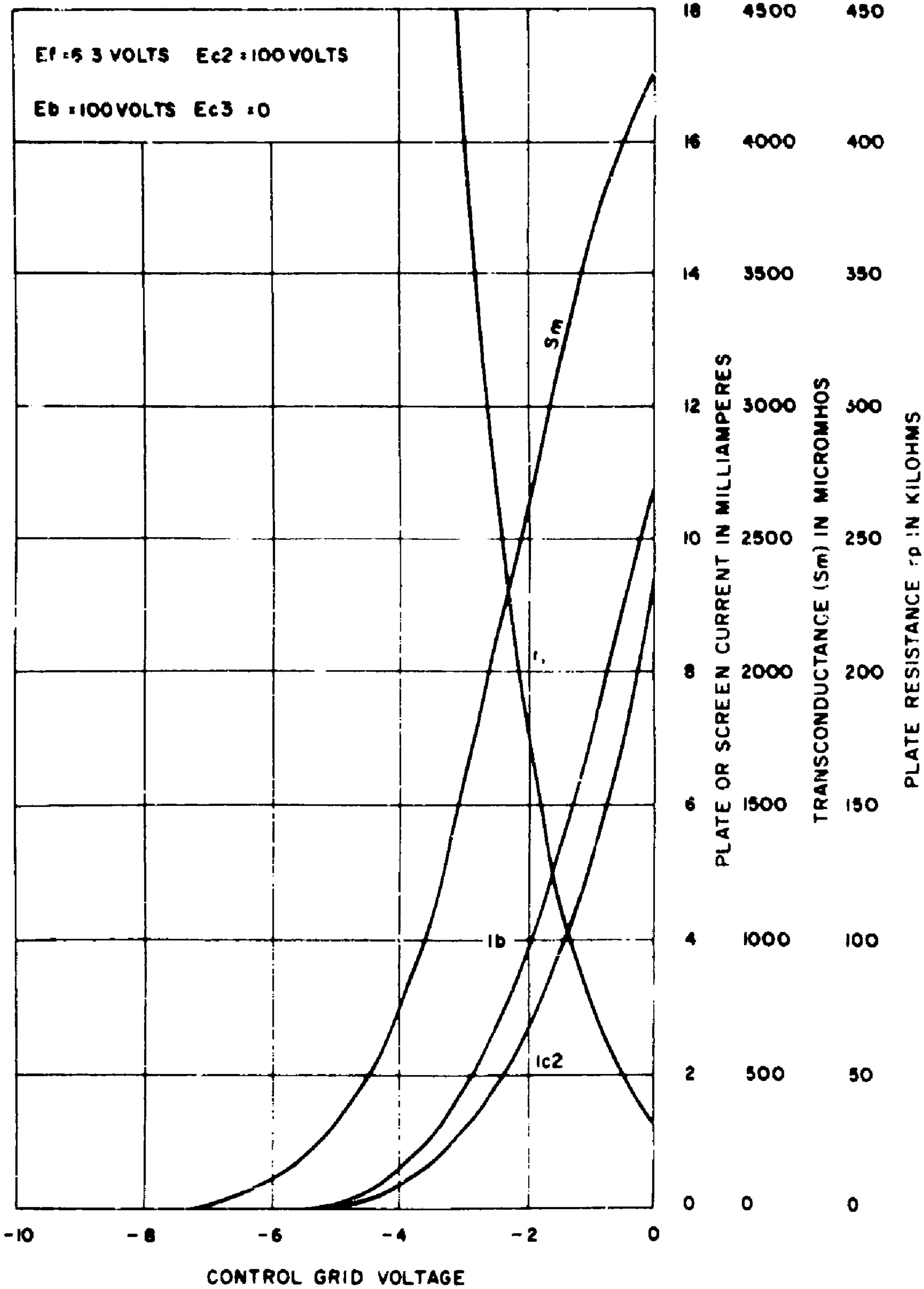


Figure 3-146. **Typical Transfer Characteristics of JAN-5636**

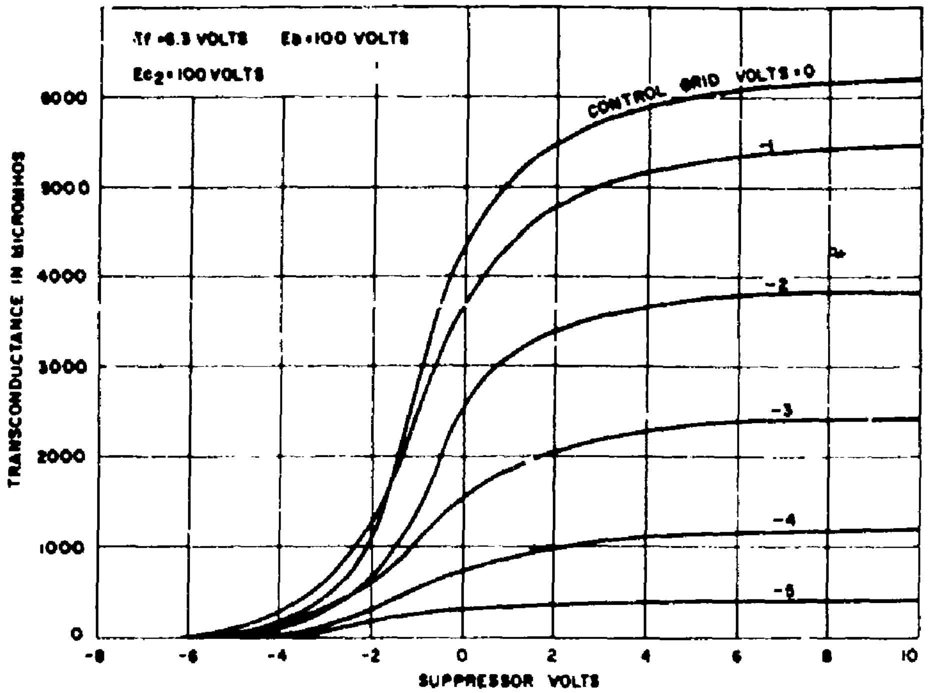


Figure 3-147. Typical Grid No. 1 to Plate Transconductance Characteristics of JAN-5636

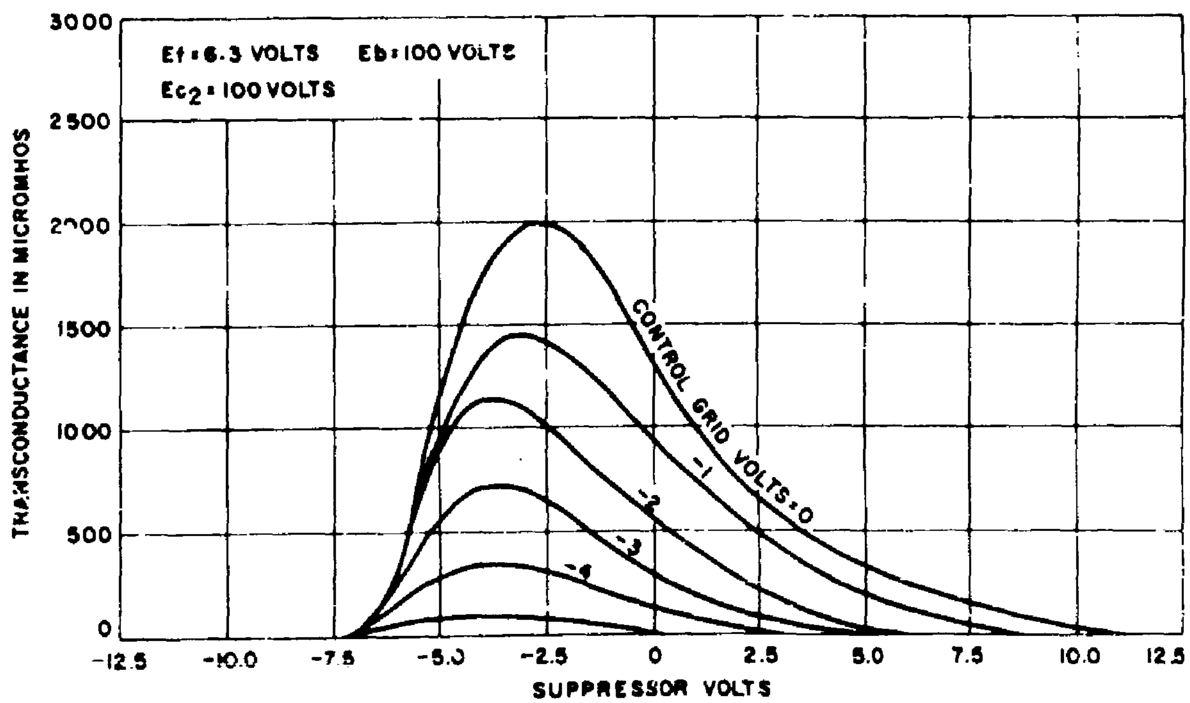


Figure 3-148. Typical Grid No. 3 to Plate Transconductance Characteristics of JAN-5636

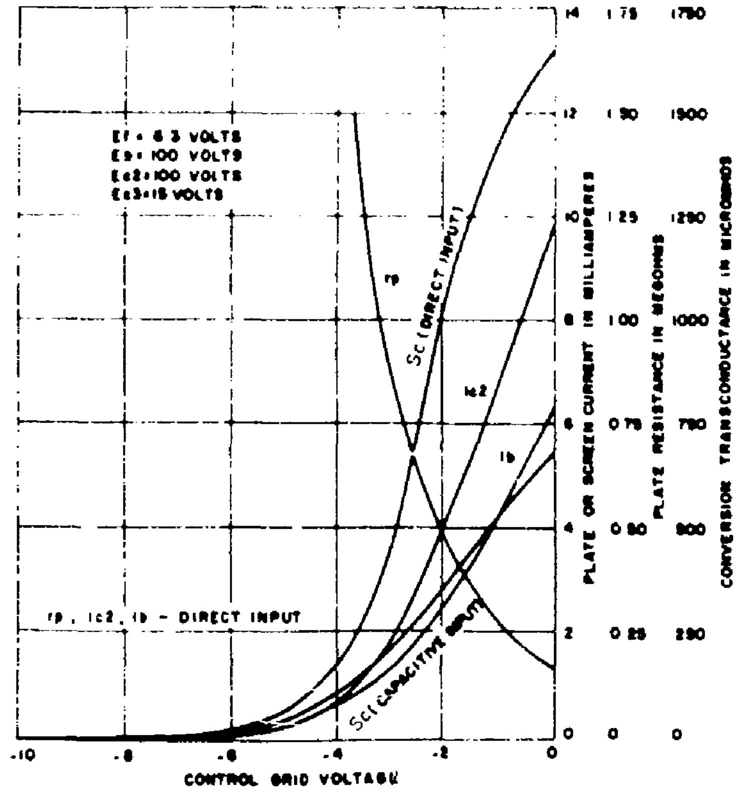


Figure 3-149. Typical Conversion Characteristics of JAN-5636

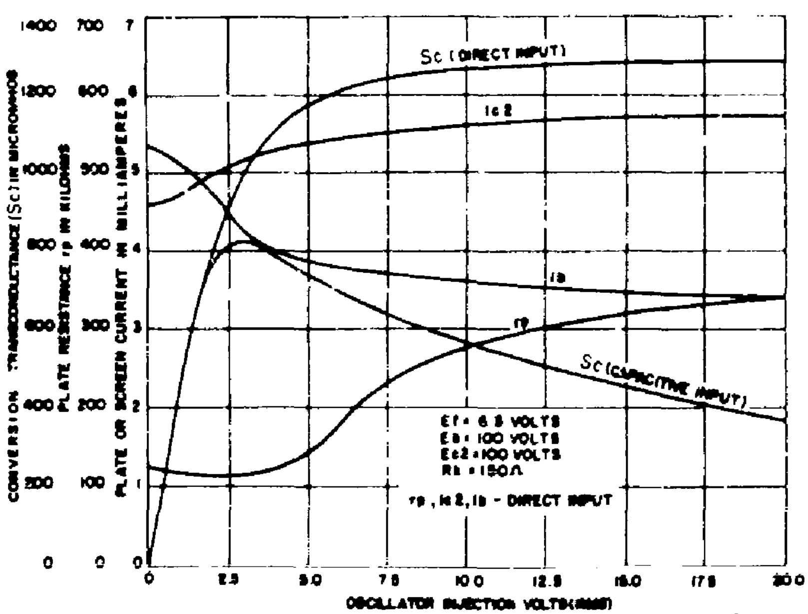


Figure 3-150. Typical Conversion Characteristics of JAN-5636

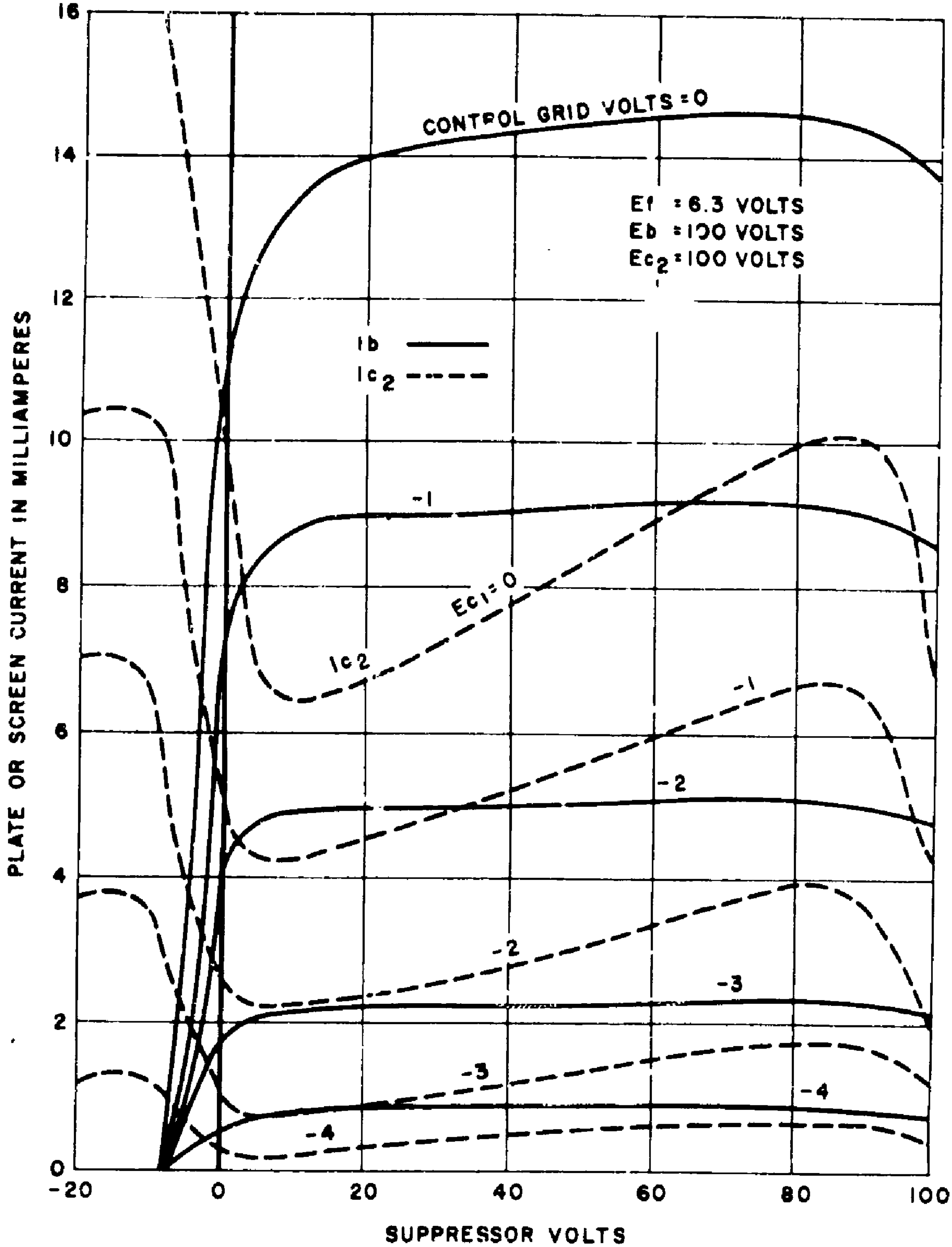


Figure 3-151. Typical Plate-Suppressor Grid Characteristics of JAN-5636

SECTION 27

TUBE TYPE JAN-5639

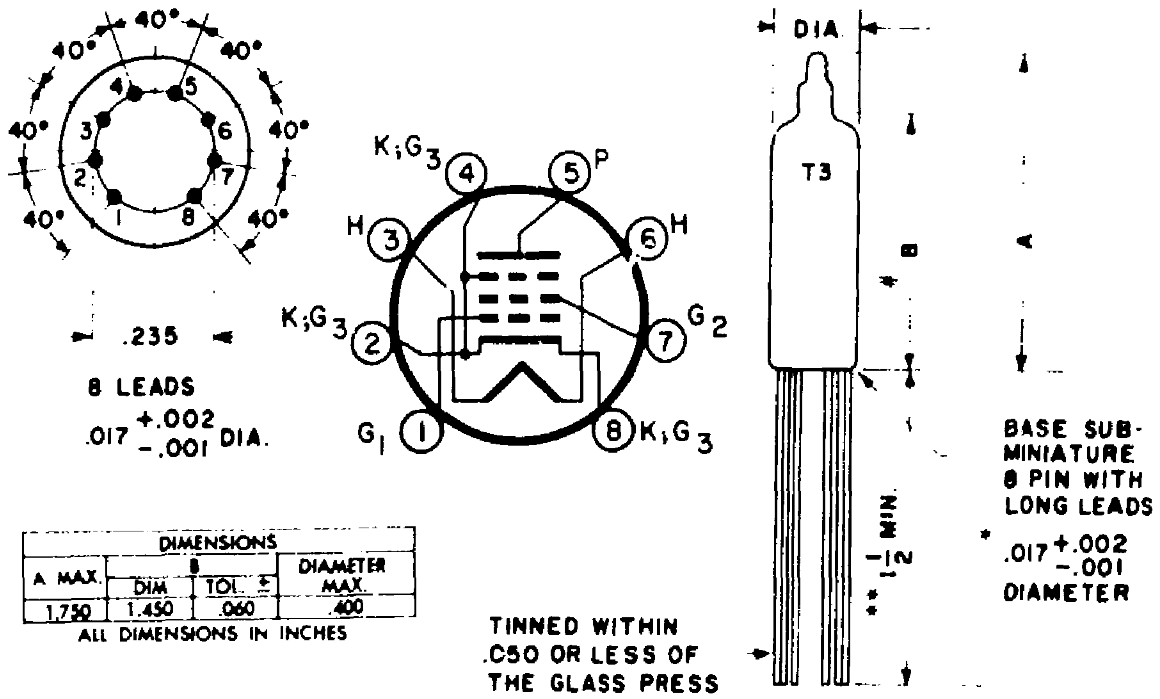
3.27 DESCRIPTION.

3.27.1 The JAN-5639 1/ is an 8-lead, button-base subminiature pentode having a transconductance in the range 7500 to 10,500 micromhos. This type has been used successfully in video circuits.

3.27.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage .... 6.3 V
Heater Current, Design Center ....0.450 A
Cathode .... Coated Unipotential

3.27.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX.
	DIM	TOL. ±	
1.750	1.450	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER

Figure 3-152. Outline Drawing and Base Diagram of Tube Type JAN-5639

1/ The values and specification comments presented in this section are related to MIL-E-1/169C dated 23 June 1955.

3.27.4 RATINGS, ABSOLUTE SYSTEM.

3.27.5 The absolute maximum ratings are as follows:

Heater Voltage	6.3 V ± 0.3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
* Screen Voltage	155 Vdc
Control Grid Voltage, Maximum	0 Vdc
Control Grid Voltage, Minimum	-55 Vdc
Heater-Cathode Voltage	200 v
Grid Series Resistance	0.5 Meg
** Cathode Current	40 mAdc
Plate Dissipation	3.5 W
* Screen Dissipation	1.0 W
Bulb Temperature	200° C
Altitude Rating	60,000 ft

3.27.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.27.7 Test conditions and design center characteristics are as follows:

Heater Voltage	6.3 V
Plate Voltage	150 Vdc
Screen Grid Voltage	100 Vdc
Cathode Resistor	100 ohms
Heater Current	450 mA

3.27.8 ACCEPTANCE TEST LIMITS.

3.27.9 Table 3-41 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/169C dated 23 June 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.27.10 APPLICATION.

3.27.11 Figure 3-153 shows the permissible operating area for JAN-5639 as defined by the ratings in MIL-E-1/169C dated 23 June 1955. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

3.27.12 Table 3-42 lists general considerations for the applications of this tube type. The numbers refer to the applicable paragraphs of this Manual.

3.27.13 SPECIAL OPERATING CONSIDERATIONS.

3.27.14 Although the specification for this tube type imposes an initial power output requirement of 0.75 watt under test conditions with a 2-volt signal and Rp = 9000 ohms, no life test assurance is afforded.

TABLE 3-41. ACCEPTANCE TEST LIMITS OF JAN-5639

PROPERTY		MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIMITS LIFE TEST MIN	LIMITS LIFE TEST MAX	UNITS
Heater Current	If		420	480	414	492	mA
Transconductance (1)	Sm		7500	10500	---	---	umhos
Change in individuals	$\Delta \frac{Sm}{t}$		---	---	---	20	%
Plate Resistance	rp		.040	---	---	---	Meg
Plate Current (1)	Ib		14.0	28.0	---	---	mAdc
Screen Current	Ic2		2.0	6.0	---	---	mAdc
Power Output	Po	Esig = 2 Vac Rp = 9000	0.75	---	---	---	W
Capacitance	Cg1p	405" dia. shield	---	0.13	---	---	uuf
	Cin	" " "	8.0	[illegible]	---	---	uuf
	Cout	" " " Ef = 0	7.0	9.0	---	---	uuf
Grid Current	Ic	Rg1 = 1.0 Meg	0	-1.0	0	-2.0	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	---	15	---	60	uAdc
	Ihk	Ehk = -100 Vdc	---	-15	---	-60	uAdc
Insulation of Electrodes	R(g-all)	Eg-all = -100 Vdc	100	---	50	---	Meg
	R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

TABLE 3-42. APPLICATION PRECUATIONS FOR JAN-5639

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15
- Fixed, 1.3.8, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation 3.2.13
Triode Connection 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.27.15 VARIABILITY OF CHARACTERISTICS.

3.27.16 The following charts show the amount of variation which may be expected among individual tubes. The variability boundaries were determined from the specified acceptance limits.

3.27.17 Figure 3-154 presents the limit behavior of static plate characteristics for JAN-5639 as defined by MIL-E-1/169C dated 23 June 1955.

3.27.18 Figure 3-155 presents the limit behavior of plate transfer data for JAN-5639 as defined by MIL-E-1/169C dated 23 June 1955.

3.27.19 DESIGN CENTER CHARACTERISTICS.

3.27.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.27.21 Figure 3-156 presents the static plate characteristic of JAN-5639.

3.27.22 Figure 3-157 presents the typical plate transfer data for JAN-5639.

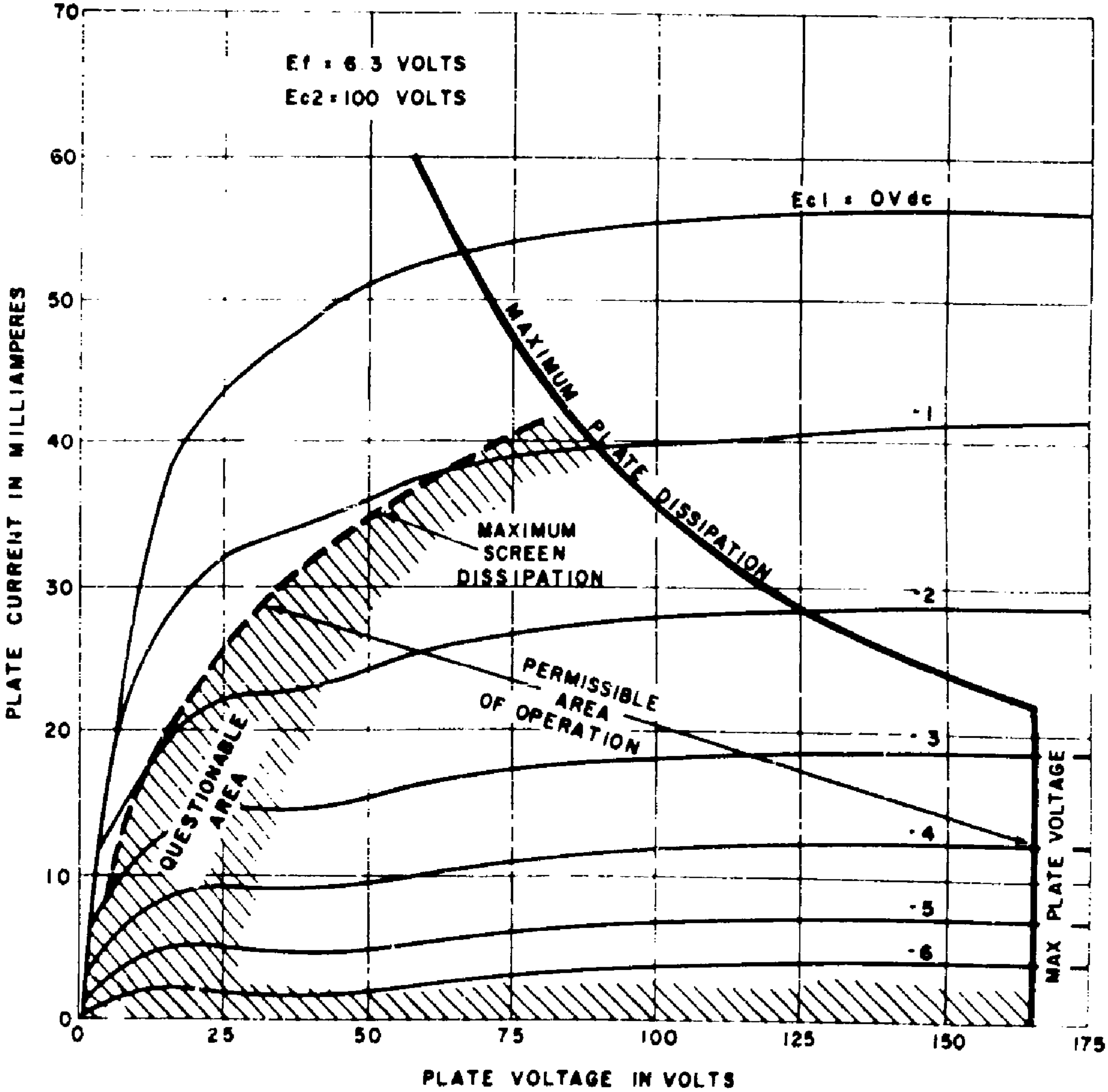


Figure 3-153. Typical Static Plate Characteristics of JAN-5639; Permissible Area of Operation

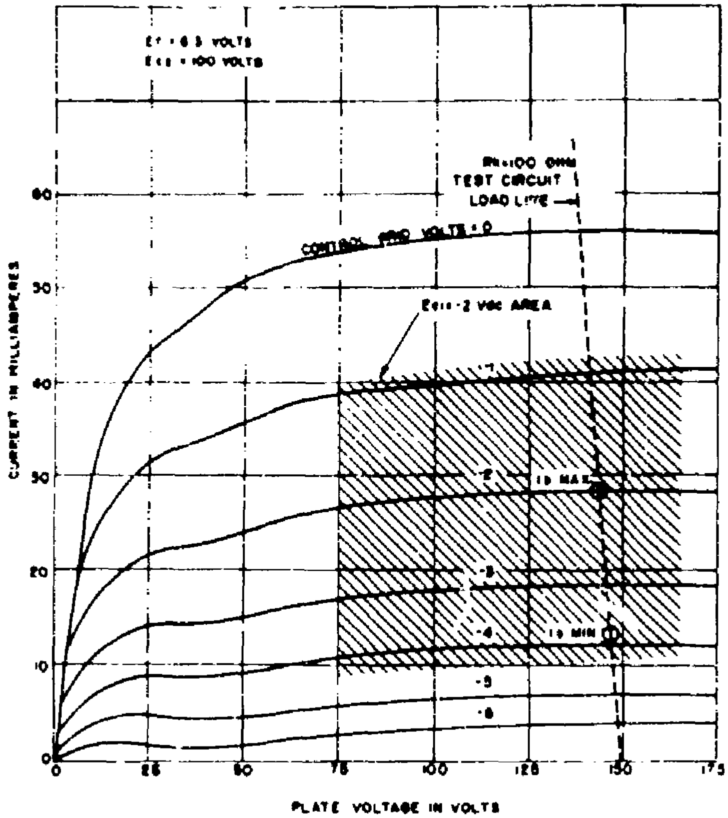


Figure 3-154. Limit Behavior of JAN-5639 Static Plate Data; Variability of Ib

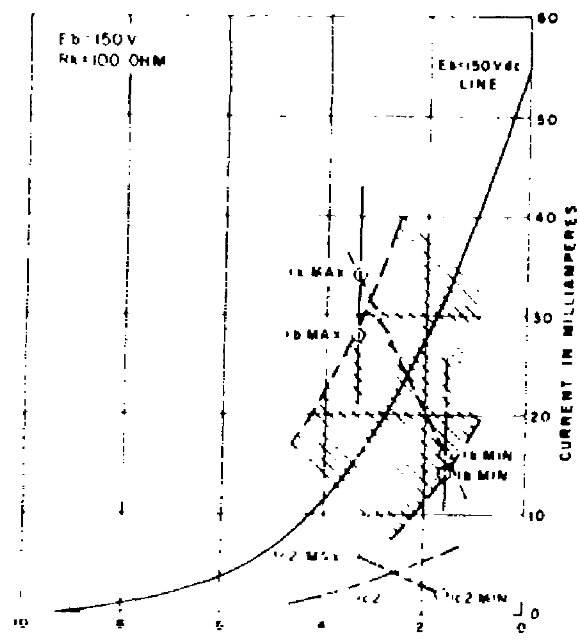


Figure 3-155. Limit Behavior of JAN-5639 Transfer Data; Variability of Ib and Ic2

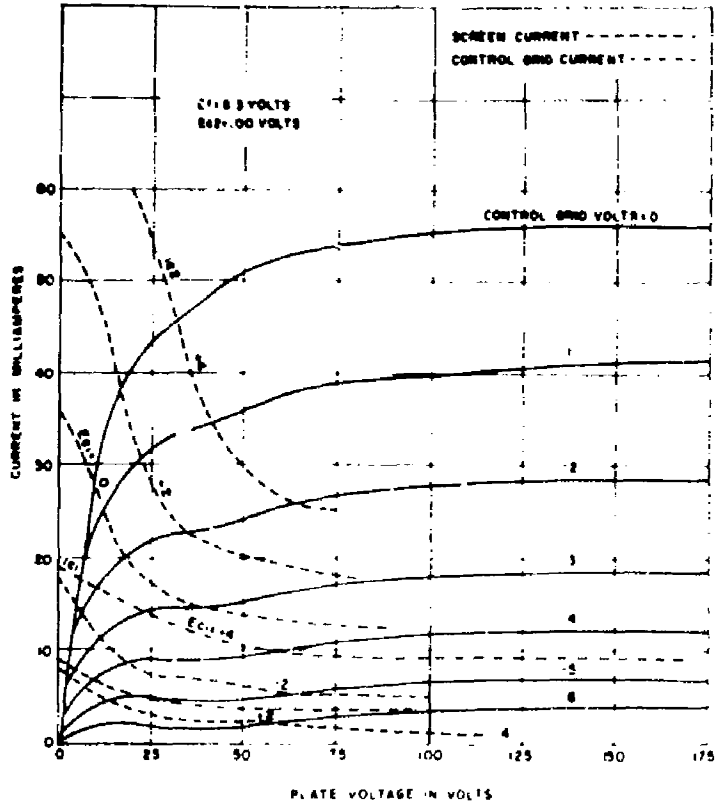


Figure 3-156. Typical Static Plate Characteristics of JAN-5639

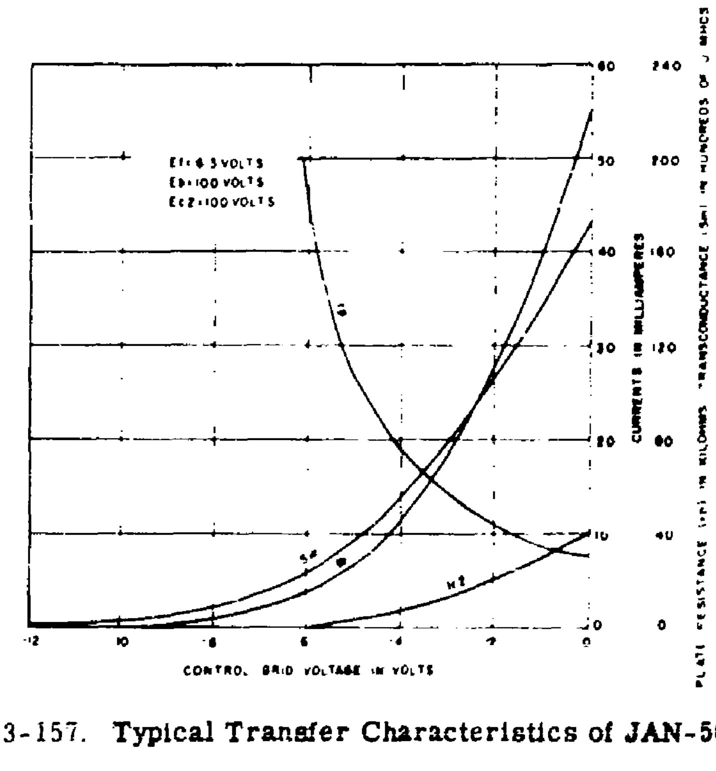


Figure 3-157. Typical Transfer Characteristics of JAN-5639

SECTION 28

TUBE TYPE JAN-5641

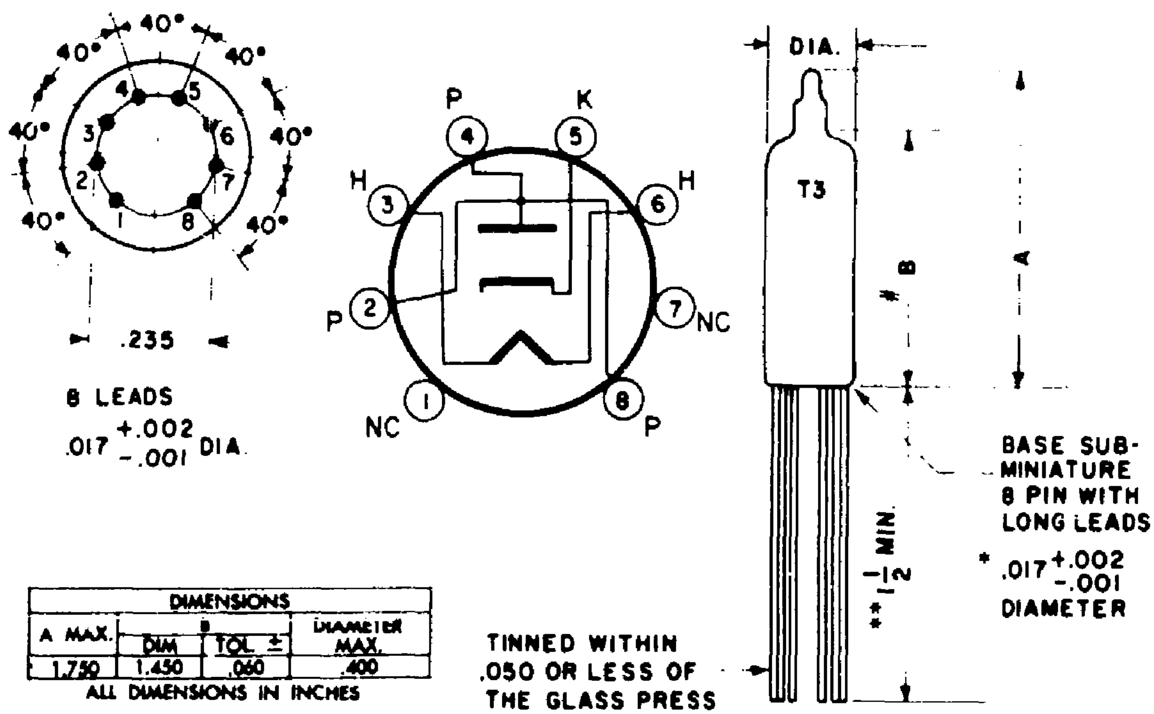
3.28 DESCRIPTION.

3.28.1 The JAN-5641 1/ is an eight-pin, button-base, subminiature half-wave high-vacuum rectifier suitable for operation where the average d-c current per plate does not exceed 50 milliamperes.

3.28.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	6.3 V
Heater Current	450 mA
Cathode	Coated Unipotential

3.28.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B DIM	B TOL. ±	DIAMETER MAX.
1.750	1.450	.060	.400

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-158. Outline Drawing and Base Diagram of Tube Type JAN-5641

1/ The values and specification comments presented in this section are related to MIL-E-1/170A dated 26 October 1954.

3.28.4 RATINGS, ABSOLUTE MAXIMUM.

3.28.5 The absolute maximum ratings are as follows:

Heater Voltage	6.3 V ± 0.3 V
Peak Inverse Plate Voltage	775 v
* Steady State Peak Plate Current per Plate	300 ma
Output Current, per plate	50 mAdc
Transient Peak Plate Current	1.1 a
Heater Cathode Voltage	±465 v
Bulb Temperature	+220° C
Altitude Rating	60,000 ft

3.28.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.28.7 The test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Secondary Voltage to Plate, Epp	275 Vac
Load Resistance (RL)	5000 ohms
Load Capacitor (CL)	16 uf
Heater Current	450 mA

3.28.8 ACCEPTANCE TEST LIMITS.

3.28.9 Table 3-43 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/170A dated 26 October 1954 should be referenced to determine further as- of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

TABLE 3-43. ACCEPTANCE TEST LIMITS OF JAN-5641

PROPERTY		MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIMITS LIFE TEST MIN	LIMITS LIFE TEST MAX	UNITS
Heater Current	If		420	480	414	492	mA
Operation	Io		47	---	43	----	mAdc
Emission	Is	Eb = 30 Vdc	100	---	---	---	mAdc
Heater-Cathode Leakage	Ihk	Ehk = +465 Vdc	---	50	---	100	uAdc
	Ihk	Ehk = -465 Vdc	---	-50	---	-100	uAdc

* A test of this property at 250 ma exists.

3.28.10 APPLICATION.

3.28.11 RATING CHARTS.

3.28.12 Rating Charts I, II and III represent areas of permissible operation within which any application of the JAN-5641 must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.28.13 RATING CHART I. Rating Chart I (Figure 3-159) is based on maximum rated peak inverse voltage (epx) of 775 volts and maximum rated d-c output current (Io) of 50 milliamperes. Point C corresponds to the simultaneous occurrence of these two ratings and also corresponds to the life test conditions using capacitor-input filter.

3.28.14 RATING CHART II. Rating Chart II (Figure 3-160), for capacitor input filter applications, is based on maximum rated d-c output current (Io) and maximum rated steady-state peak plate current (Ib) of 300 milliamperes. Rectification efficiency must not exceed 0.65 under conditions of maximum rated d-c output current. Rectification efficiency is equivalent to

$$\frac{Eo}{1.4\ Epp/p}$$

where Eo equals the d-c output voltage at filter input in volts and Epp/p equals rms supply voltage per plate in volts. (Rs = 240 ohms per plate.)

3.28.15 RATING CHART III. Rating Chart III (Figure 3-161), for capacitor input filter applications, is based on maximum rated surge current (i surge) of 1.1 amperes per plate. Minimum permissible series resistance (Rs) is approximately 240 ohms per plate under conditions of maximum permissible supply voltage.

3.28.16 OTHER CONSIDERATIONS.

3.28.17 HEATER VOLTAGE. Heater voltage considerations are discussed in paragraph 3.3.9.

3.28.18 ALTITUDE. Paragraph 3.3.7 contains a discussion of high altitude considerations.

3.28.19 TYPICAL CHARACTERISTICS.

3.28.20 Figure 3-162 presents the static plate characteristic of JAN-5641, reproduced from data published by the original RETMA registrant of the type. The variation which may be exhibited among individual tubes cannot be inferred from the specification which provides a minimum limit only on emission.

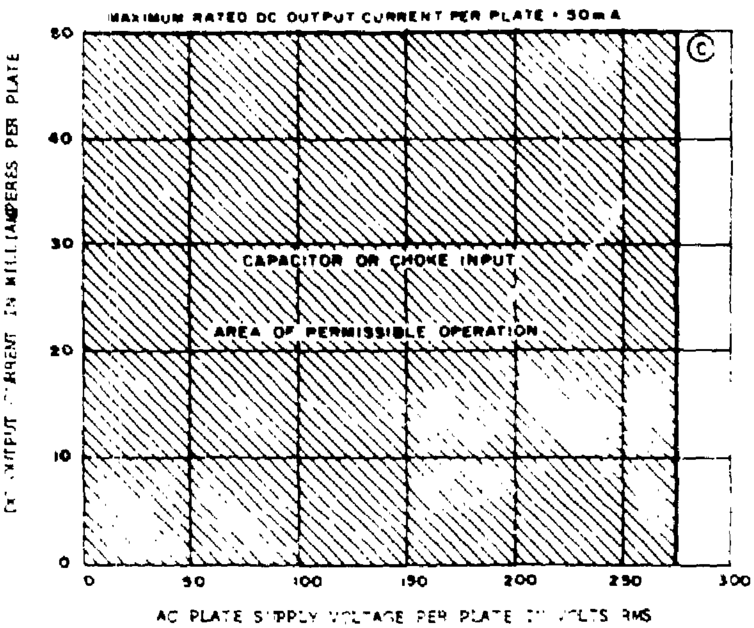


Figure 3-159. Rating Chart I for Tube Type JAN-5641 Showing Permissible Operating Area for Choke and Capacitor-Input Circuits

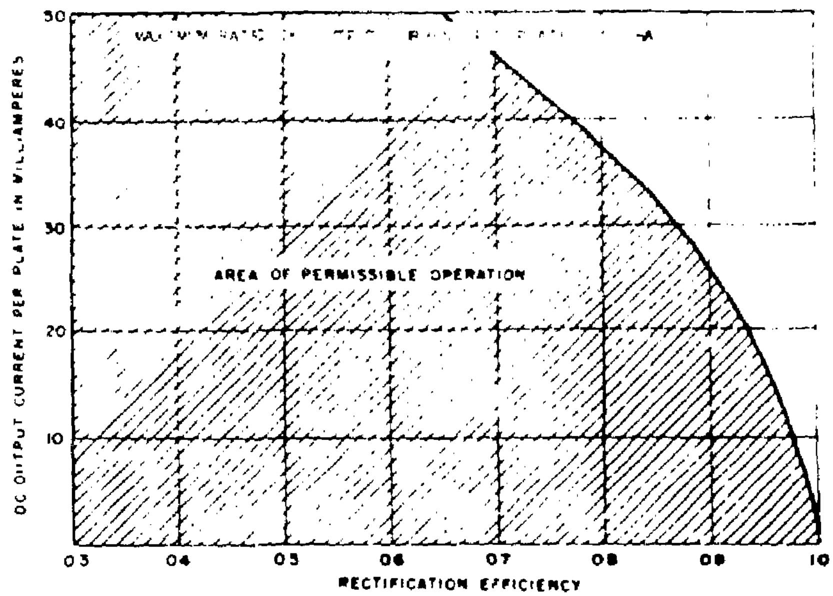


Figure 3-160. Rating Chart II for Tube Type JAN-5641 Showing Permissible Operating Area for Capacitor Input Filter Operation

If Series Inductance is Present in the Plate Supply, Rs may be Less than shown Provided i Surge does not exceed 1.1 Amperes.

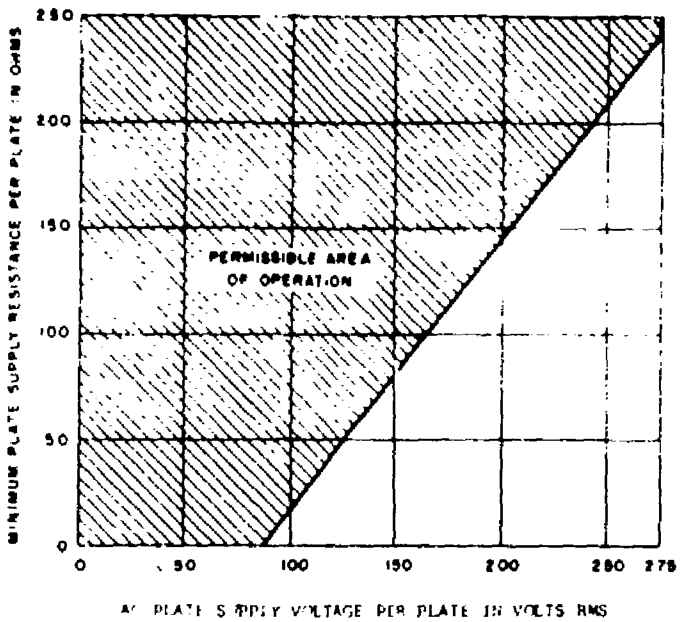


Figure 3-161. Rating Chart III - JAN-5641, for Capacitor Input Filter

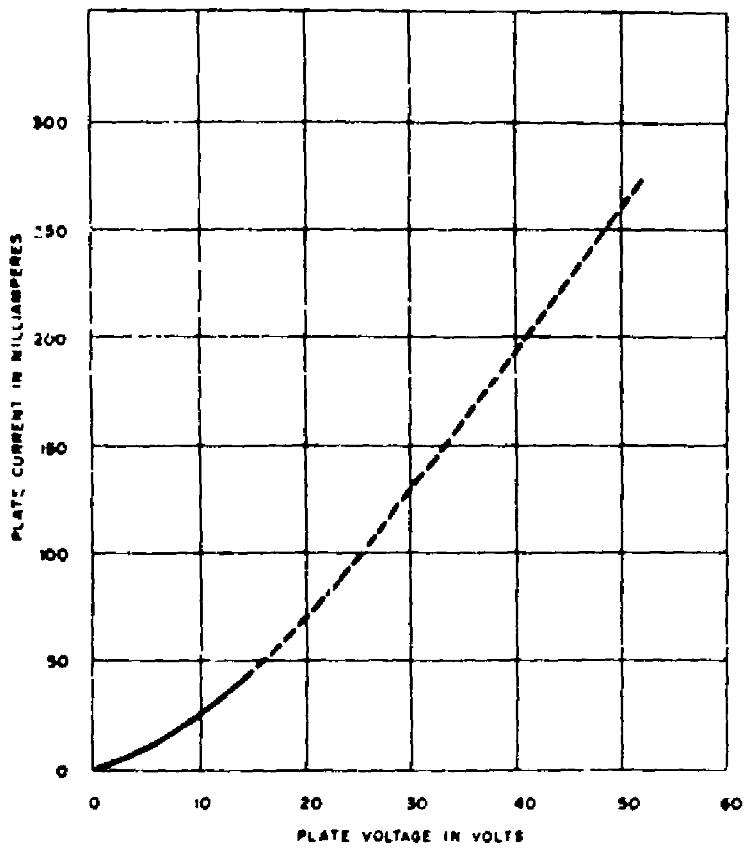


Figure 3-162. Typical Plate Characteristics of JAN-5641

SECTION 29

TUBE TYPE JAN-5647

3.29 DESCRIPTION.

3.29.1 The JAN-5647 1/ is a four lead, button base, subminiature, diode.

3.29.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	6.3 V
Heater Current, Design Center	150 mA
* Cathode	Coated Unipotential

3.29.3 MOUNTING. Not specified.

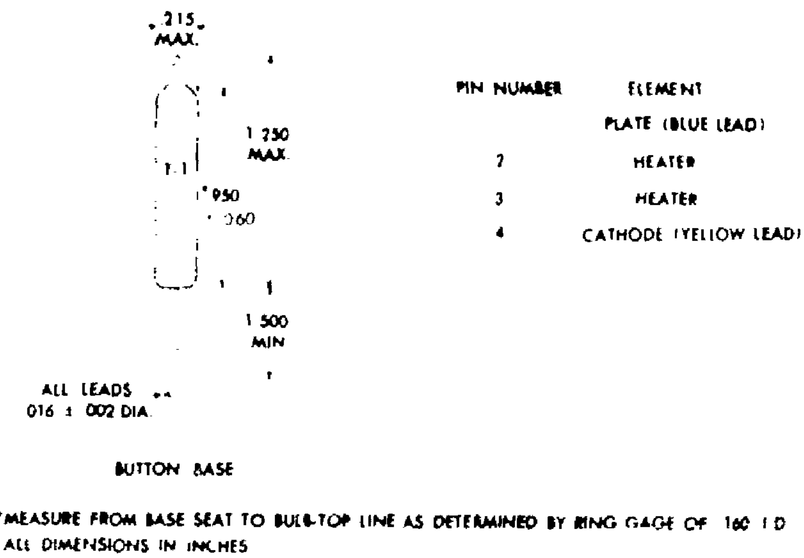


Figure 3-163. Outline Drawing and Base Diagram of Tube Type JAN-5647

3.29.4 RATINGS, ABSOLUTE SYSTEM.

3.29.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.3 V
Peak Inverse Plate Voltage	460 v
Heater-Cathode Voltage	360 v
Steady State Peak Plate Current	60 ma
Output Current	10 mAdc
Transient Peak Plate Current	350 ma
Bulb Temperature	220° C
Altitude Rating	60,000 ft

* Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

1/ The values and specification comments presented in this section are related to MIL-E-1/204B dated 23 June 1955.

3.29.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.29.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Supply Voltage, Epp	165 Vac
Load Resistance (Unity Power Factor), RL	15,000 ohms
Load Capacitance, CL	8 uf
Heater Current, If	150 mA

3.29.8 ACCEPTANCE TEST LIMITS.

3.29.9 Table 3-44 summarizes salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/204B dated 23 June 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

Note: In a half wave circuit, adjust Zp so that a bogie tube gives Io - 10 mAdc. A bogie tube has a drop of Etd = 6.0 Vdc at Is = 45 mAdc.

3.29.10 APPLICA. N.

3.29.11 SIGNAL RECTIFIER SERVICE: In the application of JAN-5647 in signal rectifier service, Fig. 3-164 relates boundaries of permissible operation and the questionable area of operation, to the plate characteristics.

3.29.12 Permissible steady state peak plate current is limited to 60 milliamperes to define boundary (1), and dc output current is limited to 10 milliamperes to define boundary (2). Area (3) is defined as questionable from the standpoint of uniformity and stability of plate current in low-level signal rectifier applications. Reference should be made to Section 1.3.4 for a review of the behavior of initial electron velocity and contact potential in tubes in general, where control grid currents discussed are equivalent to plate currents in signal diode application.

TABLE 3-44. ACCEPTANCE TEST LIMITS OF JAN-5647

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		140	160	138	164	mA
Plate Current	Ib	Ebb = 0; Rp = 40,000	5	25	---	---	uAdc
Operation	Io	See Note Below	9.3	---	8.5	---	mAdc
Change in Operation Current from initial	Δ_tIo		---	---	---	15	%
Emission	Is	Eb = 6.0 Vdc	25	---	---	---	mAdc
Capacitance (0.220 in	Cpk	Ef = 0	1.70	3.30	---	---	uuf
diameter shield)	Ckh	Ef = 0	4.3	5.7	---	---	uuf
	Cph	Ef = 0	1.0	2.6	---	---	uuf
Heater-Cathode Leakage	Ihk	Ehk = 360 Vdc	---	20	---	60	uAdc
	Ihk	Ehk = -360 Vdc	---	-20	---	-60	uAdc
Insulation of Electrodes	R(p-all)	Ep-all = -300 Vdc	20	---	10	---	Meg

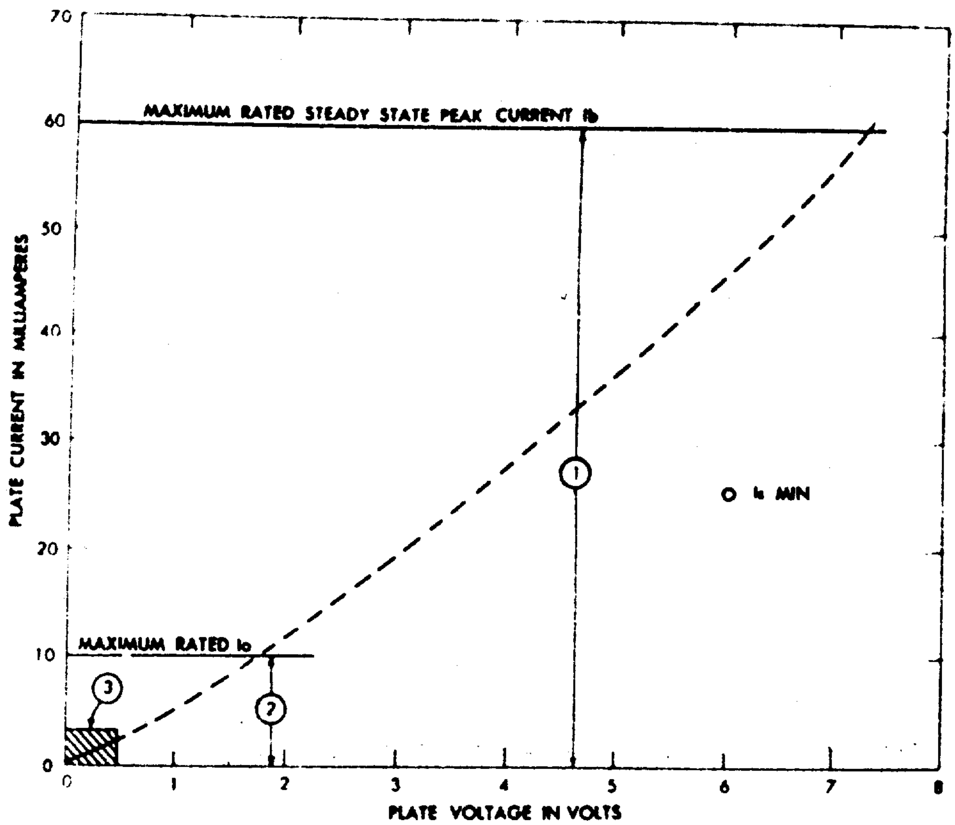


Figure 3-164. Typical Plate Characteristics of JAN-5647; Permissible Area of Operation

3.29.13 SUPPLY VOLTAGE RECTIFIER SERVICE: Rating Charts I, II and III represent areas of permissible operation within which any application of the JAN-5647 must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

3.29.14 RATING CHART I is based on maximum rated peak inverse voltage (epx) of 460 volts and maximum rated dc output current (Io) of 10 milliamperes. Point C corresponds to the simultaneous occurence of these two ratings permissible under capacitor- or choke-input filter conditions.

3.29.15 RATING CHART II for capacitor input filter applications is based on maximum rated dc output current (io) and maximum rated steady state peak plate current (ib) of 60 milliamperes. Rectification efficiency must not exceed 0.68 under conditions of maximum rated dc output current.

3.29.16 RATING CHART III for capacitor input filter is based on maximum rated surge current (I surge) of 350 milliamperes. Minimum permissible series resistance (Rs) is approximately 545 ohms under conditions of maximum permissible supply voltage.

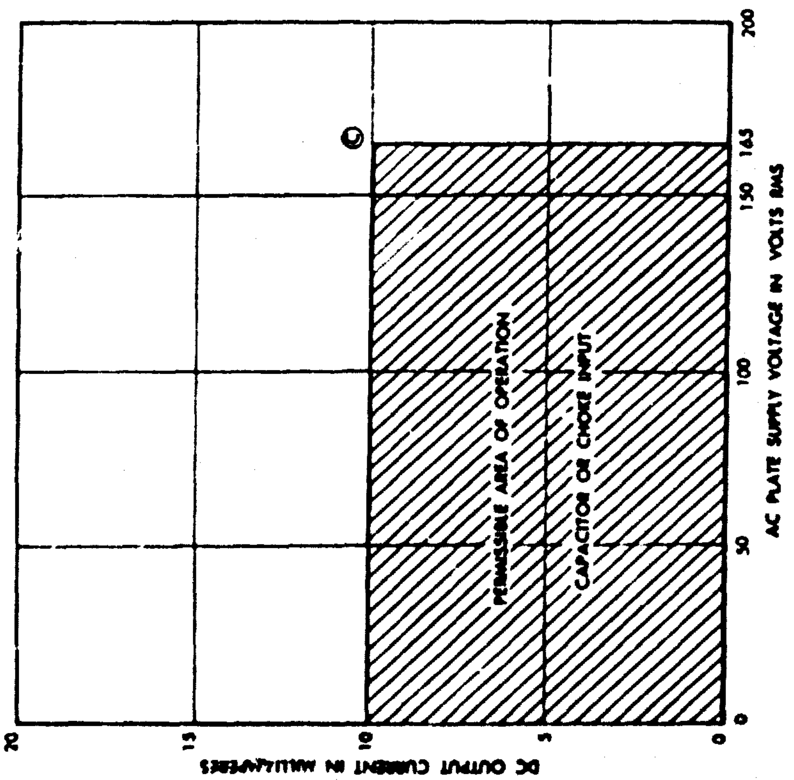


Figure 3-165. Rating Chart I for Tube Type JAN-5647

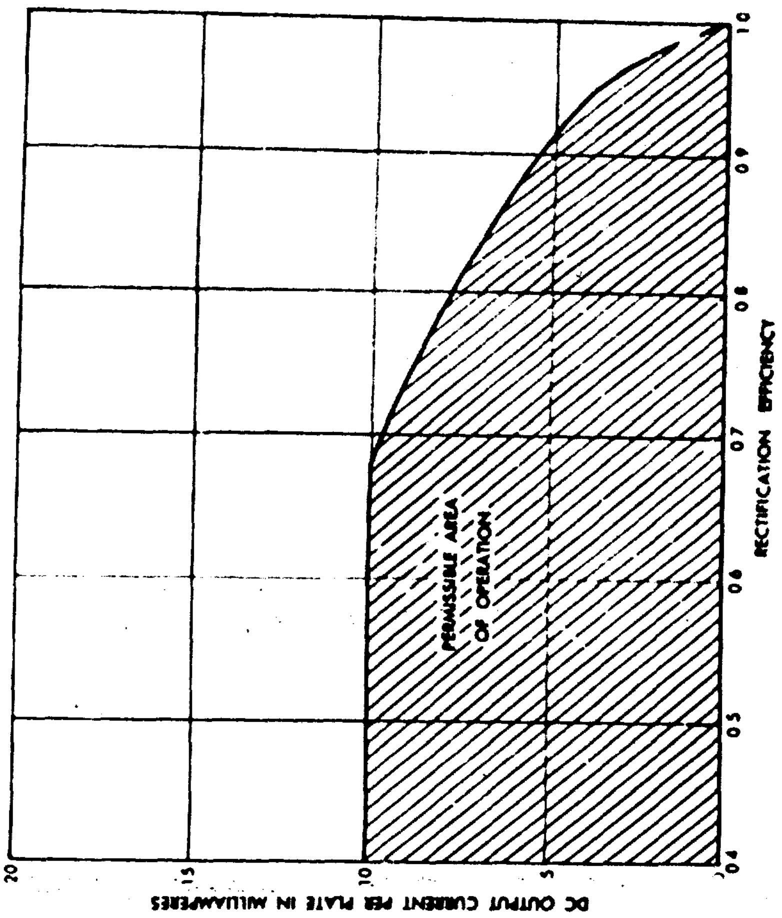


Figure 3-166. Rating Chart II for Tube Type JAN-5647

3.29.17 OTHER CONSIDERATIONS.

3.29.18 HEATER VOLTAGE: See paragraph 3.4.8.

3.29.19 LOW ELECTRODE CURRENT: See paragraph 3.4.7.

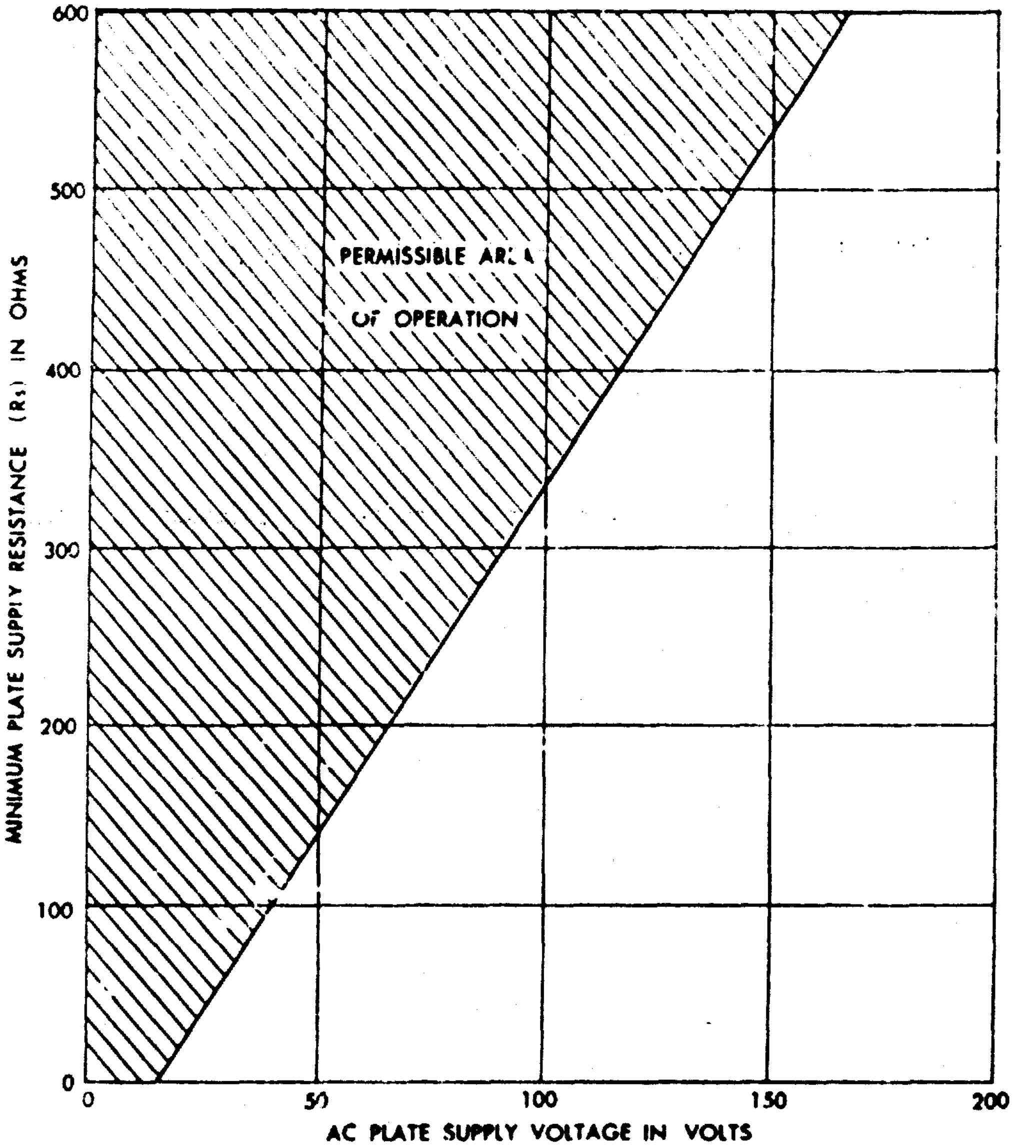


Figure 3-167. Rating Chart III for Tube Type JAN-5647

3.29.20 Values of Rs are Based on Maximum Rated Surge Current (i surg of 350 mA. If series inductance is present in the Plate supply, Rs may be less than shown provided i surge does not exceed 350 mA.

3.29.21 TYPICAL CHARACTERISTICS OF JAN-5617.

3.29.22 The chart below presents the Static Plate Characteristic of JAN-5647, reproduced from data published by the original RETMA registrant of the type. The variation which must be expected among individual tubes cannot be inferred from the specification which provides a minimum limit only on emission.

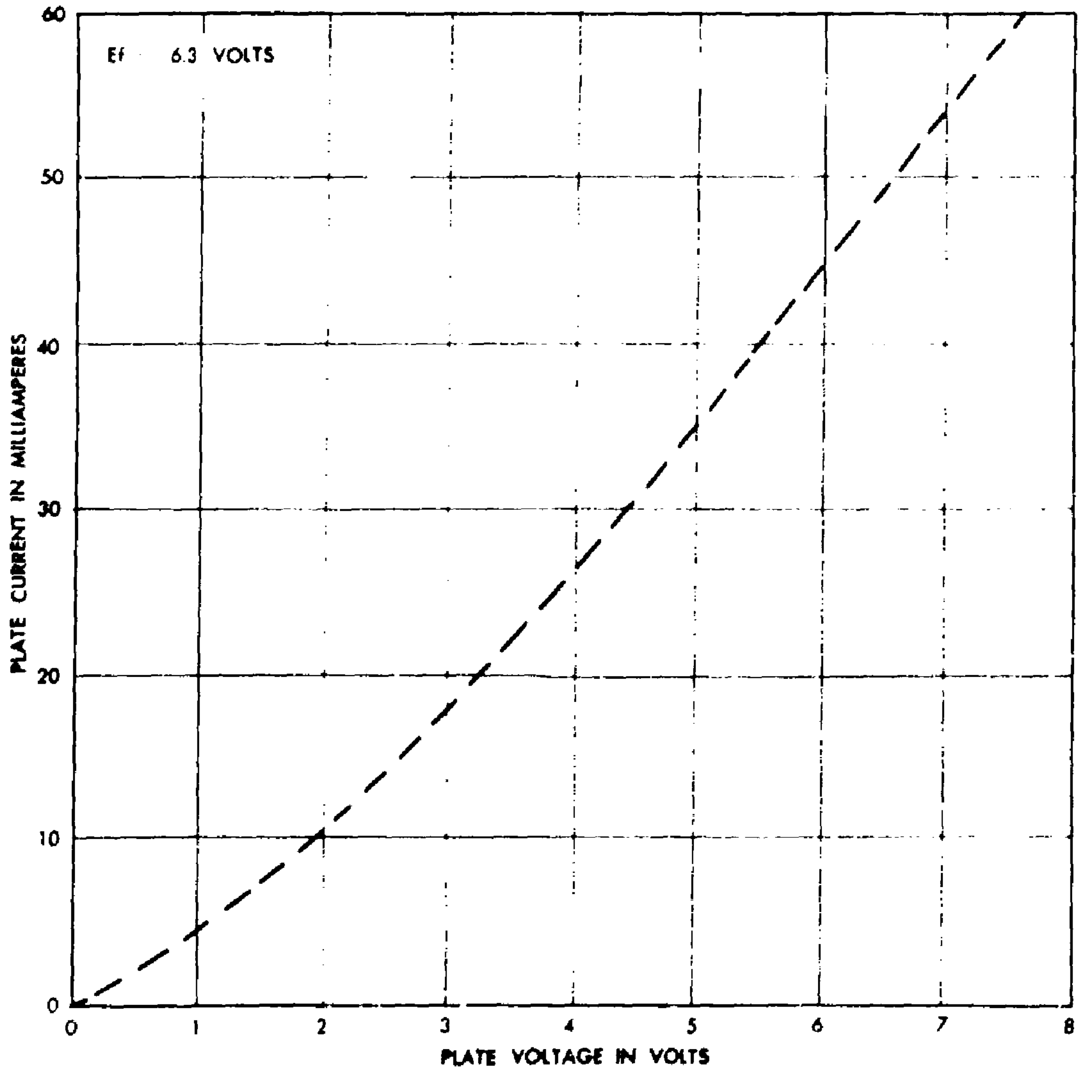


Figure 3-168. Typical Plate Characteristics of JAN-5647

SECTION 30

TUBE TYPE JAN-5654/6AK5W

3.30 DESCRIPTION.

3.30.1 The JAN-5654/6AK5W 1/ is a 7 pin miniature, sharp-cutoff pentode having a design center transconductance of 5000 micromhos.

3.30.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	6.3V
Heater, Current, Design Center	175 mA
Cathode	Coated Unipotential

3.30.3 MOUNTING. Not specified.

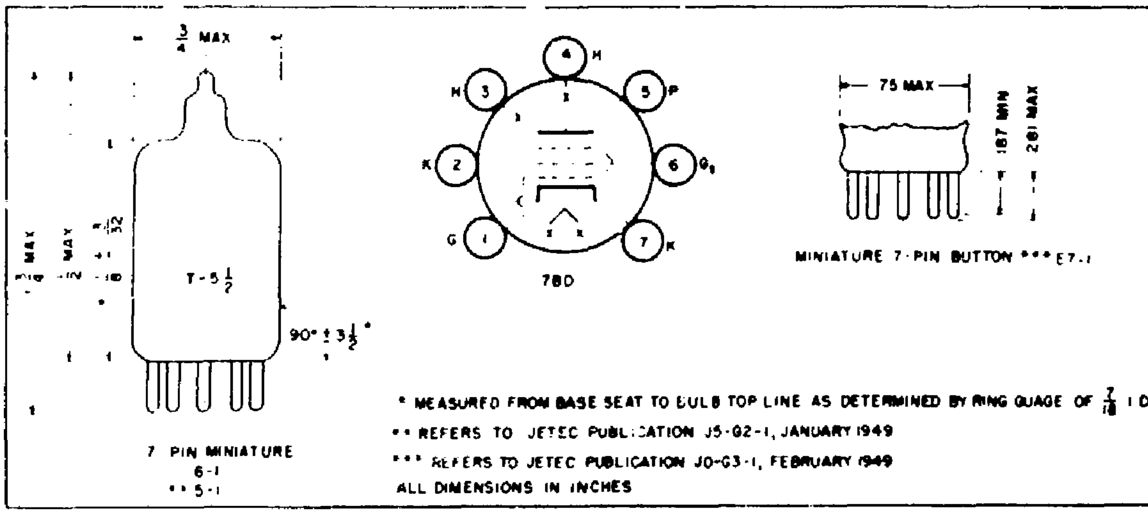


Figure 3-169. **Outline Drawing and Base Diagram of Tube Type JAN-5654/6AK5W**

3.30.4 RATINGS, ABSOLUTE SYSTEM.

3.30.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 0.3V
Plate Voltage	200 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Control Grid Voltage, Maximum	0 Vdc
Control Grid Voltage, Minimum	-50 Vdc
Screen Grid Voltage	155 Vdc
Heater-Cathode Voltage	135 v

1/ The values and specification comments presented in this section are related to MIL-E-1/4A dated 5 December 1955.

* Cathode Current, Maximum . . . . 20 mAdc
Plate Dissipation . . . . 1.65 W
* Screen Grid Dissipation . . . . 0.55 W
Bulb Temperature . . . . 165°C
* Altitude Rating . . . . 60,000 ft
Control Grid Series Resistor . . . . 0.1 meg
* Control Grid Current . . . . 1.0 mAdc

3.30.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.30.7 Test conditions and design center characteristics are as follows:
Heater Voltage, Ef . . . . 6.3 V
Plate Voltage, Eb . . . . 120 Vdc
Control Grid Voltage, Ec1 . . . . -2 Vdc
Heater Cathode Voltage, Ehk . . . . 0 Vdc
Screen Grid Voltage, Ec2 . . . . 120 Vdc
Plate Current, Ib . . . . 7.5 mAdc
Screen Grid Current, Ic2 . . . . 2.5 mAdc
Interelectrode Capacitance (Shield No. 316)
C in . . . . 4.0 uuf
C out . . . . 2.85 uuf

3.30.8 ACCEPTANCE TEST LIMITS.

3.30.9 Table 3-45 summarizes certain salient requirements set forth by the specificiation for which acceptance test limits exist, This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/4A dated 5 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test at this rating exists in the specification.

TABLE 3-45. ACCEPTANCE TEST LIMITS OF JAN-5654/6AK5W

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		160	190	160	190	mA
Transconductance (1)	Sm		3800	6200	---	---	umhos
Transconductance (1) Change in individuals	Δ_tSm		---	---	---	20	%
Average change	AvgΔ_tSm		---	---	---	15	%
Transconductance (2)	Δ_{Ef}Sm		---	---	---	15	%
Plate Current (1)	Ib		5.0	11.0	---	---	mAdc
Plate Current (2)	Ib	Ecl = -10 Vdc	---	200	---	---	uAdc
Plate Current (3)	Ib	Ec = -5.5 Vdc	5.0	---	---	---	uAdc
Screen Grid Current	Ic2		0.8	4.0	---	---	mAdc
Capacitance (Shield #316)	Cglp	Ef = 0	---	.020	---	---	uuf
	Cin	Ef = 0	3.40	4.6	---	---	uuf
	Cout	Ef = 0	2.45	3.25	---	---	uuf
Grid Current	Icl	Rgl = 0.5 Meg	0	-0.1	0	-0.1	uAdc
Grid Emission	Isc	Ef = 7.5 V; Ecl = -45 V; Rgl = 0.1 Meg	0	-0.5	---	---	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	---	10	---	10	uAdc
	Ihk	Ehk = -100 Vdc	---	-10	---	-10	uAdc
Insulation of Electrodes	Rg-all	E =100 Vdc; gl Neg	100	---	50	---	Meg
	Rp-all	E =300 Vdc; p Neg	100	---	50	---	Meg

3.30.10 APPLICATION.

3.30.11 Figure 3-170 a and b below shows the permissible operating areas for JAN-5654/6AK5W as defined by the ratings in MIL-E-1/4A dated 5 December 1955. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7

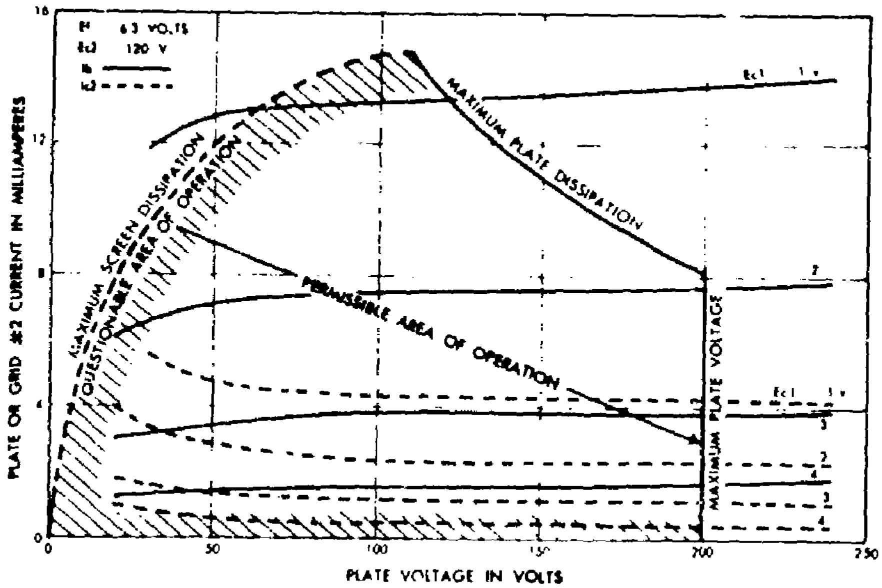


Figure 3-170. Typical Plate Characteristics of JAN-5654/6AK5W; Permissible Area of Operation

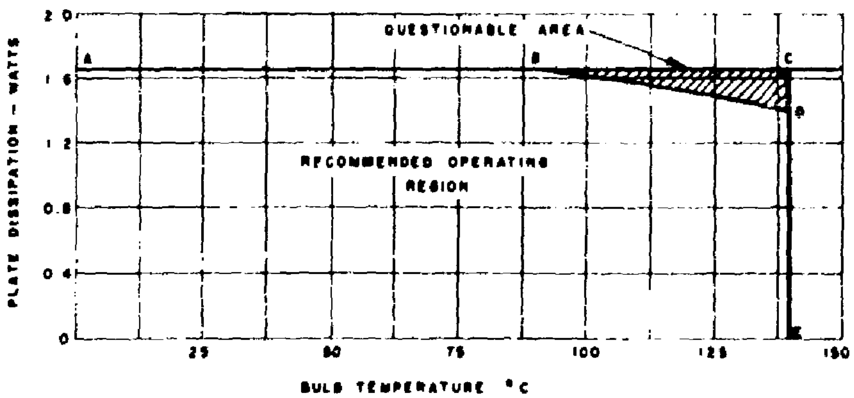


Figure 3-171. Plate Dissipation and Bulb Temperature in the Operating Area for Electron Tube Type JAN-5654/6AK5W

3.30.12 Table 3-46 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-46. APPLICATION PRECAUTIONS FOR JAN-5654/6AK5W

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
  High, 3.2.12
  Low, 3.2.3 3.2.7
  28 Volt, 3.2.21
  AC Operation, 1.3.20, 3.2.18
Screen Grid:
  Supply, 3.2.8
  Protection, 3.2.22
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
  Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.30.13 VARIABILITY OF CHARACTERISTICS.

3.30.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.30.15 Figure 3-172 presents the limit behavior of static plate characteristics for JAN-5654/6AK5W as defined by MIL-E-1/4A dated 5 December 1955.

3.30.16 Figure 3-173 presents the limit behavior of transfer data for JAN-5654/6AK5W as defined by the specification.

type.

.37

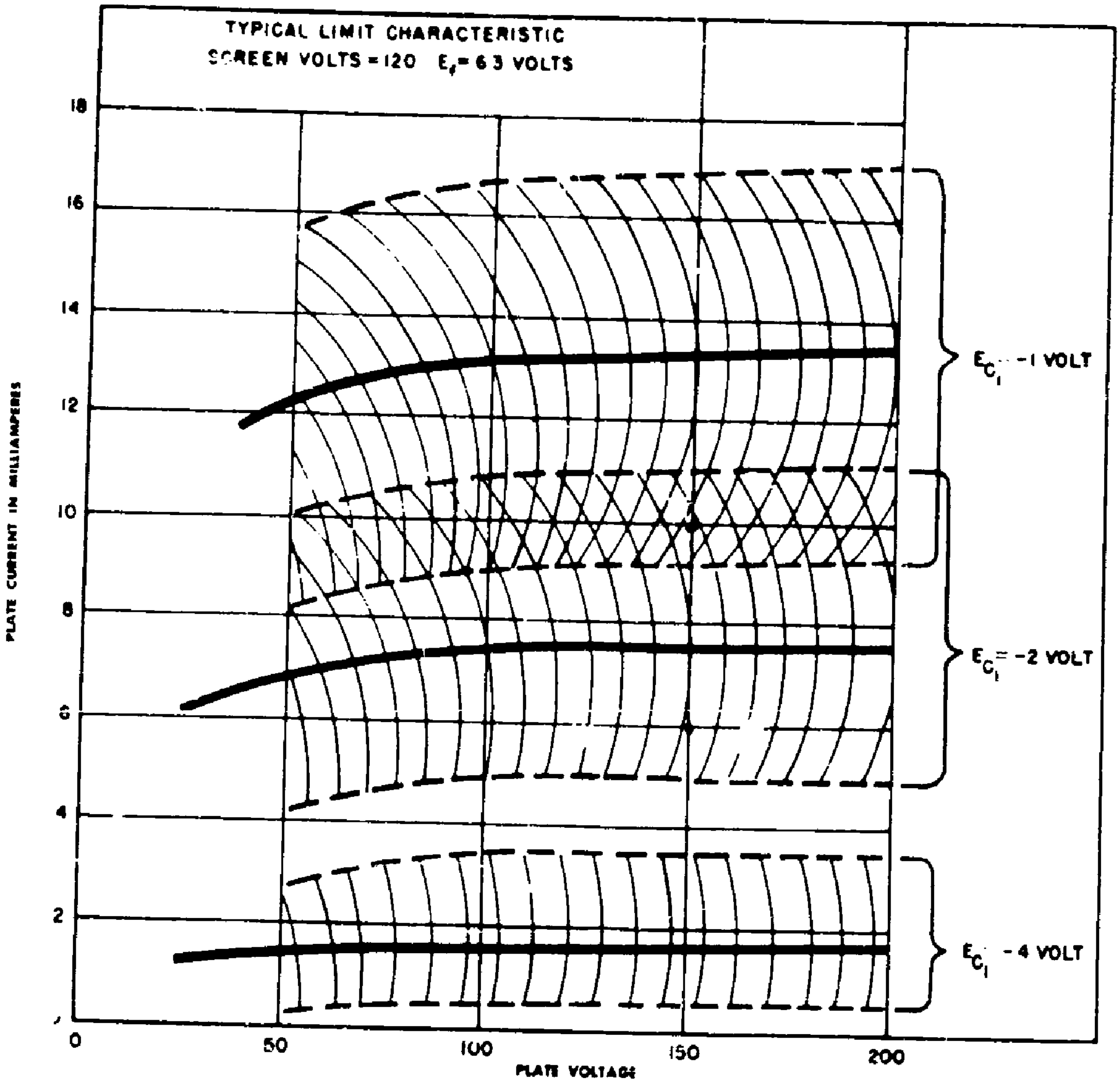


Figure 3-172. Typical Plate Voltage Limit Characteristics of Tube Type JAN-5654/6AK5W

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5654/

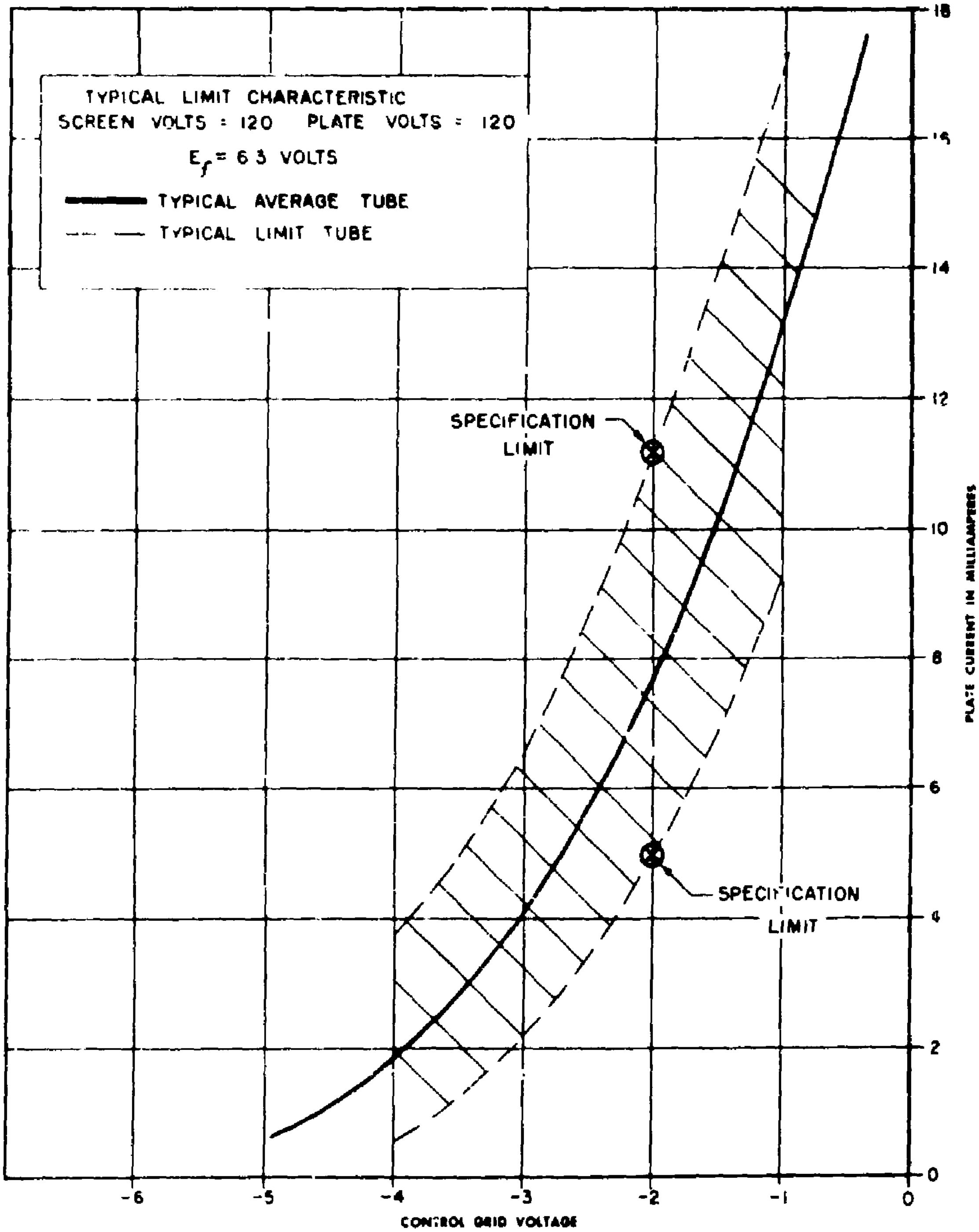


Figure 3-173. Typical Control Grid Voltage Limit Characteristics of Tube Type JAN-5654/6AK5W

3.30.17 DESIGN CENTER CHARACTERISTICS.

3.30.18 The typical curve portrayed as Figure 3-174 has been obtained from current data being published by the original RETMA registrant of this type.

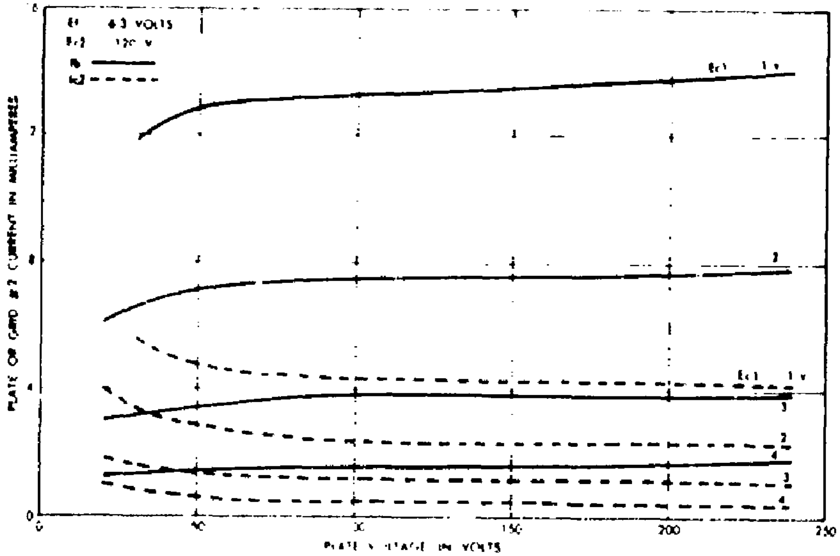


Figure 3-174. Typical Plate Characteristics of JAN-5654/6AK5W

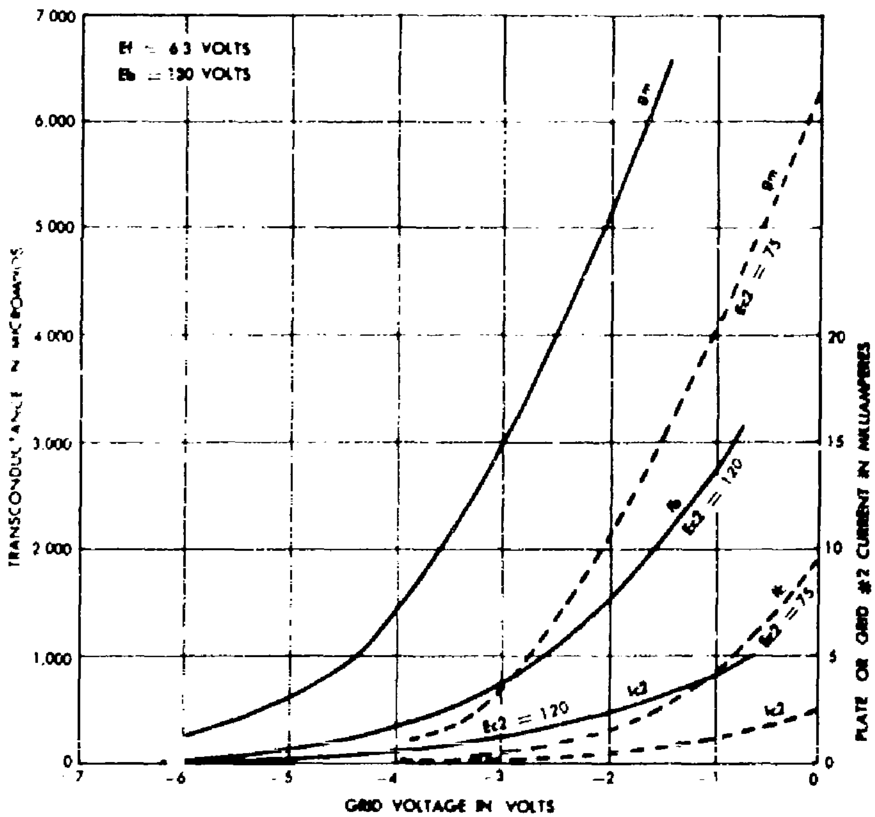


Figure 3-175. Typical Transfer Characteristics of JAN-5654 6AK5W

SECTION 31

TUBE TYPE JAN-5670

3.31 DESCRIPTION.

3.31.1 The JAN-5670 1/ is a 9 pin miniature, medium-mu (35), twin triode having a coated unipotential cathode and separate cathode connections.

3.31.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 350 mA

3.31.3 MOUNTING. Not specified.

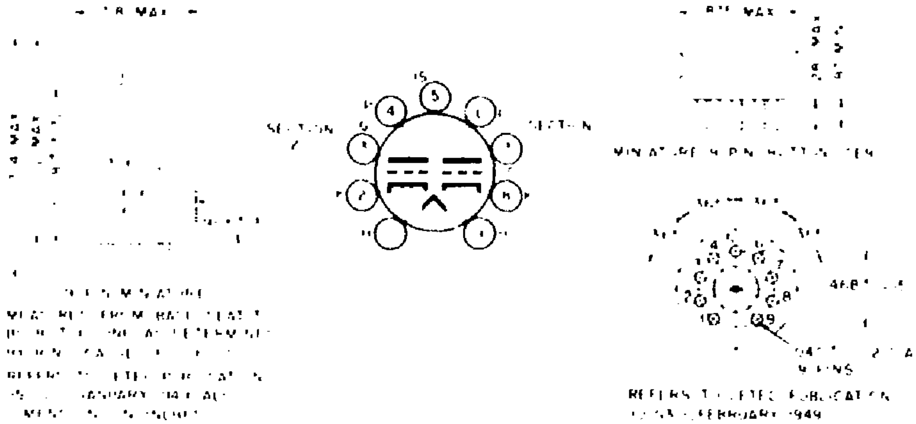


Figure 3-176. Outline Drawing and Base Diagram of Tube Type JAN-5670

3.31.4 RATINGS, ABSOLUTE SYSTEM.

3.31.5 The absolute system ratings are as follows:

Heater Voltage . . . . 6.3V ± .6V
Plate Voltage . . . . 330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Heater-CathodeVoltage. . . . . ±100 V
Control Grid Voltage Maximum . . . . 0 V
Control Grid Voltage, Minumum . . . . -55 Vdc
Control Grid Series Resistance/Grid . . . . 0.5 meg
* Control Grid Current . . . . 3.0 mAdc

---

* No test at this rating exists in the specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/5A dated 5 December 1955.

** Cathode Current, Maximum (per cathode) . . . . 18 mAdc
Plate Dissipation (per plate) . . . . 1.35 W
Bulb Temperature . . . . 165° C
Altitude Rating . . . . 60,000 ft

3.31.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.31.7 Test conditions and design center characteristics are as follows:
Heater Voltage, Ef . . . . 6.3 V
Heater Cathode Voltage, Ehk . . . . 0 V
Plate Voltage, Eb . . . . 150 Vdc
Cathode Resistance, Rk (per cathode). . . . . . 240 ohms

3.31.8 ACCEPTANCE TEST LIMITS.

3.31.9 The following table summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/5A dated 5 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-47. ACCEPTANCE TEST LIMITS OF JAN-5670

PROPERTY	MEASUREMENT CONDITIONS	LIMITS				UNITS
		INITIAL		LIFE TEST		
		MIN	MAX	MIN	MAX	
Heater Current If		330	370	330	370	mA
Transconductance (1) Sm		4500	6500	---	---	umhos
Transconductance (2) Sm Δ_{Ef}		---	15	---	15	%
Change in Transconductance (1) of individuals Δ_t Sm		---	- -	---	20	%
Transconductance average change Avg Δ_t Sm		---	---	---	15	%
Amplification Factor Mu		26	44	---	---	
Plate Current (1) Ib		5.9	10.5	---	---	mAdc
Plate Current (1) Ib difference between sections		---	1.8	---	---	mAdc
Plate Current (2) Ib	Ec = -10 Vdc; Rp = 0.25 Meg	---	45	---	---	uAdc
Plate Current (3) Ib	Ec = -4 Vdc	5	---	---	---	uAdc
Capacitance (without shield) Cgp	Ef = 0	0.8	1.4	---	---	uuf
Cin	Ef = 0	1.7	2.7	---	---	uuf
Cout	Ef = 0	0.7	1.3	---	---	uuf
Cpp	Ef = 0	---	0.10	---	---	uuf
Grid Current Ic	Rg = 0.5 Meg Max.	0	-0.3	0	-0.3	uAdc
Grid Emission Isc	Ef = 7.5 Ec = -10 Vdc	0	-0.5	---	---	uAdc
Heater-Cathode Leakage Ihk	Ehk = +100 Vdc	---	7	---	7	uAdc
Ihk	Ehk = -100 Vdc	---	-7	---	-7	uAdc
Insulation of Electrodes R(g-all)	Eg-all = -100 Vdc	100	---	50	---	Meg
R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

3.31.10 APPLICATION.

3.31.11 The chart below shows the permissible operating area for JAN-5670 as defined by the ratings in MIL-E-1/5A dated 5 December 1955. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

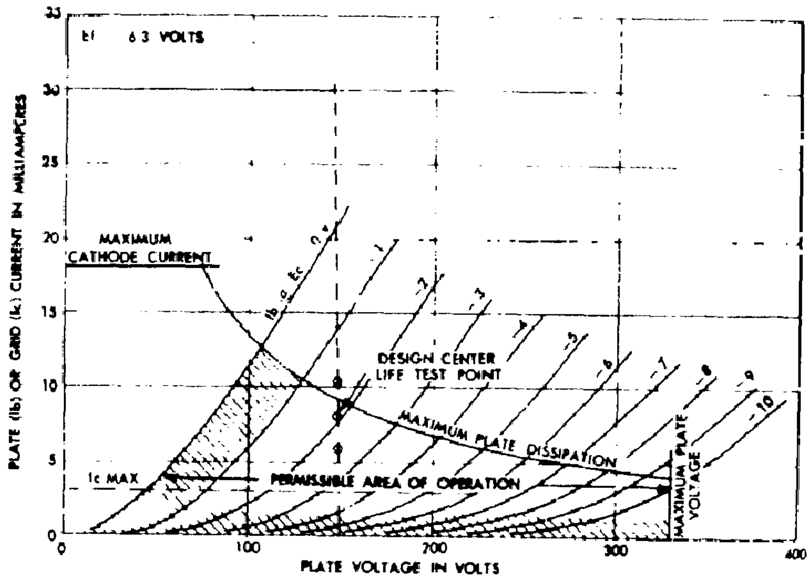


Figure 3-177. Typical Plate Characteristics of JAN-5670; Permissible Area of Operation

3.31.12 The following table lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-48. APPLICATION PRECAUTIONS OF JAN-5670

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27
1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
High, 3.1.8
Low, 3.1.15
AC Operation, 1.3.20, 3.1.10
28 Volt, 3.1.15
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.1.3
Cathode, 2.1.3, 3.1.12
Fixed, 1.3.8, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23,
3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure
Tubes, 1.3.28
Cathode, Thermionic Instability,
1.3.37

Temperature

Bulb and Environmental, 3.1.5

Resistance

Control Grid Series, 1.3.9, 1.3.19,
1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3
3.1.12

Dissipation

Plate, 2.1, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.31.13 VARIABILITY OF CHARACTERISTICS.

3.31.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.31.15 The following chart presents the limit behavior of static plate characterictics for JAN-5670 as defined by MIL-E-1/5A dated 5 December 1955.

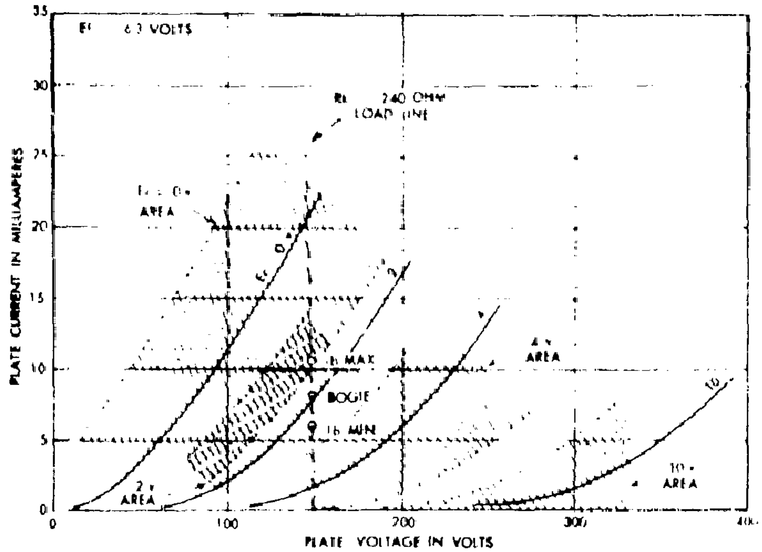


Figure 3-178. Limit Plate   aracteristics of JAN-5670

3.31.16 The following chart presents the limit behavior of transfer data for JAN-5670 as defined by MIL-E-1/5A dated 5 December 1955.

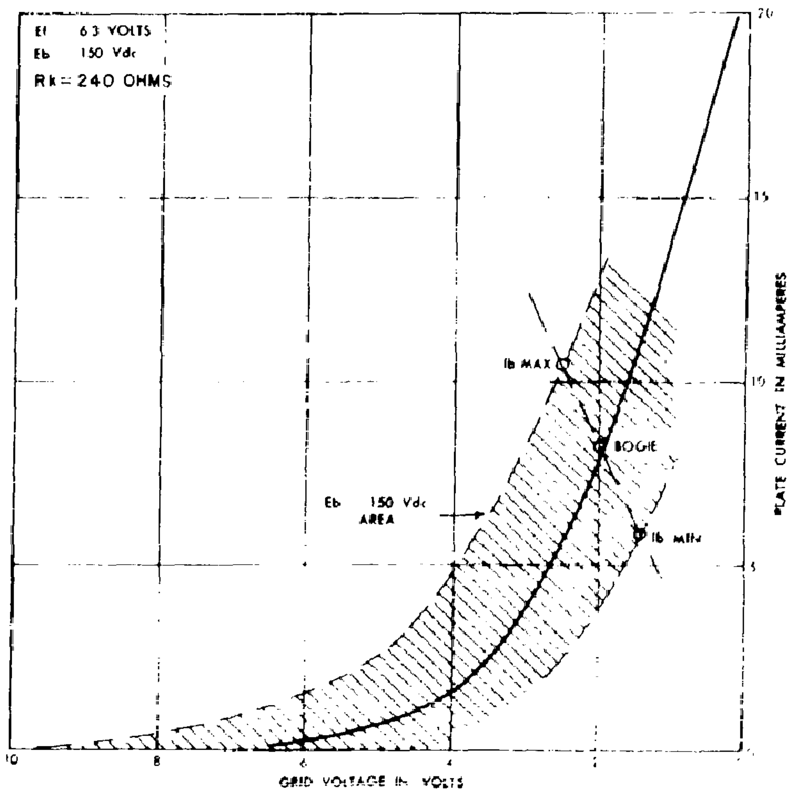


Figure 3-179. Limit Transfer Characteristics of JAN-5670

3.31.17 DESIGN CENTER CHARACTERISTICS.

3.31.18 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.31.19 Figures 3-180, 3-181, 3-182 present the Characteristics of JAN-5670 in the negative and positive grid region as well as the behavior of Sm, Mu, and rp as functions of Plate Current.

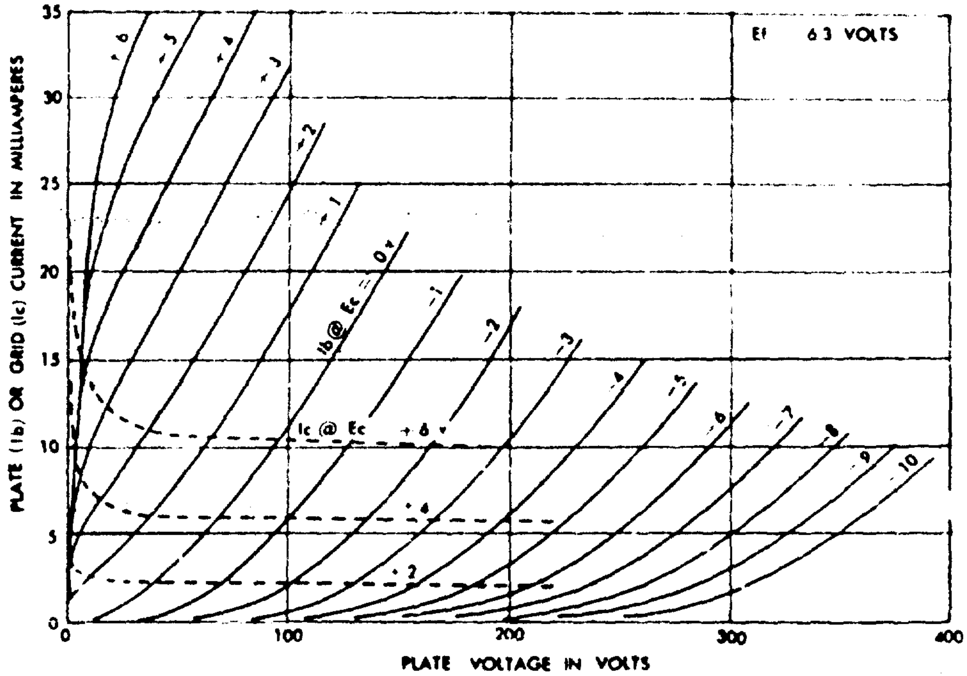


Figure 3-180. Typical Plate Characteristics of JAN-5670

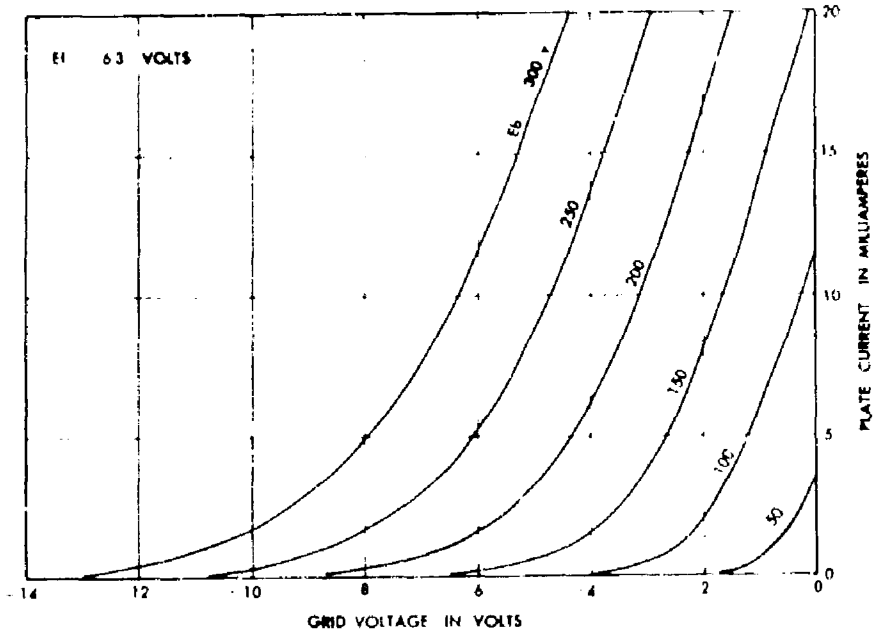


Figure 3-181. Typical Transfer Characteristics of JAN-5670

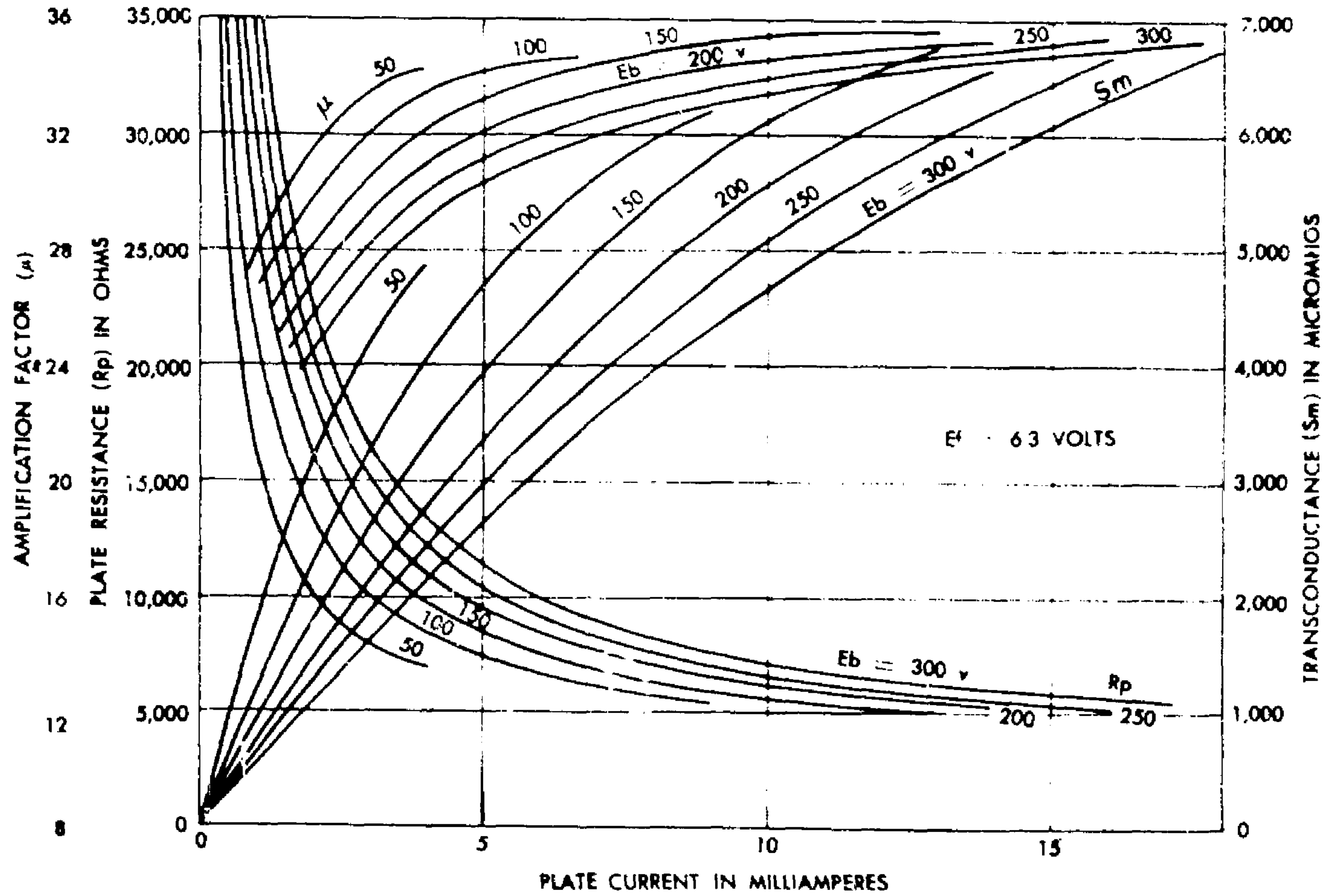


Figure 3-182. Typical JAN-5670 Characteristics
Mu and rp as Functions of Ib: Parametric in Eb

SECTION 32

TUBE TYPE JAN-5672

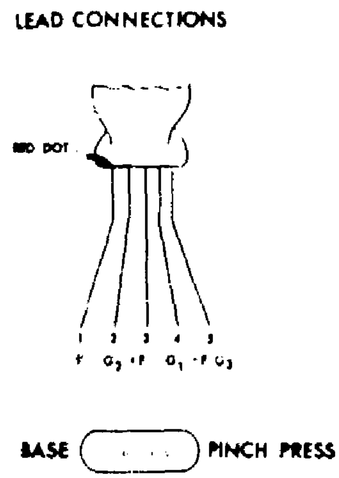
3.32 DESCRIPTION

3.32.1 The JAN-5672 1/ is a 5-lead, pinch-press, filamentary, subminiature, power-amplifier pentode, having a transconductance in range, 475 to 825 micromhos.

3.32.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 1.25 Vdc
Cathode. . . . . Coated Filament

3.32.3 MOUNTING. Not specified.



	DIMENSIONS			
A MAX.	B		DIAMETER MAX.	
	DIM	TOL. ±	C MAX	D MAX
1.500	1.300	.100	.385	.285

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

*** WHEN SPECIFIED ON THE TSS

**** APPLIES TO PINCH PRESS TYPES ONLY (.02 MIN)

GROUND LEAD OVERLAPPED BY SHIELD BY A MINIMUM OF .04

SHIELD TO GROUND WIRE MAY BE FROM EITHER SIDE OF THE MAJOR DIMENSION. ALTERNATIVE CONSTRUCTION: UNUSED OR EXTRA RANDOM LEAD IN PRESS OR BUTTON MAY BE FOLDED BACK AND WRAPPED AROUND BULB TO MAKE CONTACT WITH SHIELD.

Figure 3-183. Outline Drawing and Base Diagram of Tube Type JAN-5672

1/ The values and specification comments presented in this Section are related to MIL-E-1/280 dated 9 July 1953.

3.32.4 RATINGS, ABSOLUTE SYSTEM.

3.32.5 The absolute system ratings are as follows:

# Heater Voltage	1.25 Vdc ± 20%
Plate Voltage	100 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
* Screen Grid Voltage	100 Vdc
Cathode Current, Maximum	5.5 mAdc
* Altitude Rating	10,000 ft

3.32.6 TEST CONDITIONS.

3.32.7 Test conditions are as follows:

Heater Voltage, Ef	1.25 Vdc
Plate Voltage, Eb	67.5 Vdc
Control Grid Voltage, Ec1	-6.5 Vdc
Screen Grid Voltage, Ec2	67.5 Vdc

3.32.9 Table 3-49 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/280 dated 9 July 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

3.32.10 APPLICATION.

3.32.11 Figure 3-184 shows the permissible operating area for JAN-5672 as defined by the ratings in MIL-E-1/280 dated 9 July 1953. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.32.12 Table 3-50 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

3.32.13 SPECIAL OPERATING CONSIDERATIONS.

3.32.14 Specification for this type provides some degree of assurance initially and on life, of satisfactory performance in low-power applications, through a power output requirement of 50 milliwatts initial and 35 milliwatts life test end point, under test condition voltages with 4.55 volts of grid signal, and Rp = 20,000 ohms.

Concerning this rating, MIL-E-1/280 for JAN-5672 states, "Do not use series filament circuits."

* No test at this rating exists in the specification.

TABLE 3-49. ACCEPTANCE TEST LIMITS OF JAN-5672

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		44	56	---	---	mA
Transconductance (1)	Sm		475	825	---	---	umhos
Plate Current (1)	Ib		2.1	4.1	---	---	mAdc
Screen Grid Current	Ic2		0.5	1.4	---	---	mAdc
Power Output	Po	Esig = 4.55 Vac Rp = 20,000	50	---	35	---	mW
Control Grid Current	Ic1		0	-0.8	---	-1.5	uAdc
Insulation of Electrodes R(g1-all)		Eg1-all= -100 Vdc	100	---	---	---	Meg
R(p-all)		Ep-all = -100 Vdc	100	---	---	---	Meg

3.32.15 Specification for this type cautions against its use in series filament circuits.

3.32.16 VARIABILITY OF CHARACTERISTICS.

3.32.17 The following charts define the extent of variation which may be exhibited between individual tubes. The boundaries of this variability were determined from the acceptance limits given on the specification.

3.32.18 Figure 3-185 presents the limit behavior of static plate characteristics for JAN-5672 as defined by MIL-E-1/280 dated 9 July 1953.

3.32.19 Figure 3-186 presents the limit behavior of plate transfer data for JAN-5672 as defined by MIL-E-1/280 dated 9 July 1953.

3.32.20 DESIGN CENTER CHARACTERISTICS.

3.32.21 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.32.22 Figure 3-187 presents the static plate characteristics of JAN-5672.

3.32.23 Figure 3-188 presents the typical plate transfer data for JAN-5672.

TABLE 3-50. APPLICATION PRECUATIONS FOR JAN-5672

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27
1.3.37, 1.3.51, 1.3.55, 3.2.14

Plate:
- High, 3.2.12
- Low, 3.2.2, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19,
1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23,
3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

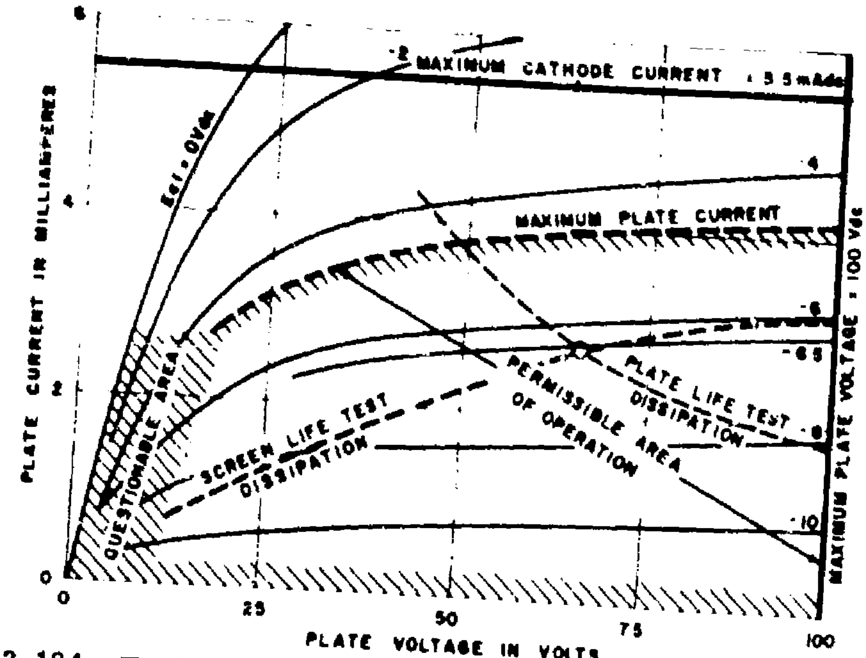


Figure 3-184. Typical Static Plate Characteristics of Tube Type JAN-5672; Permissible Area of Operation

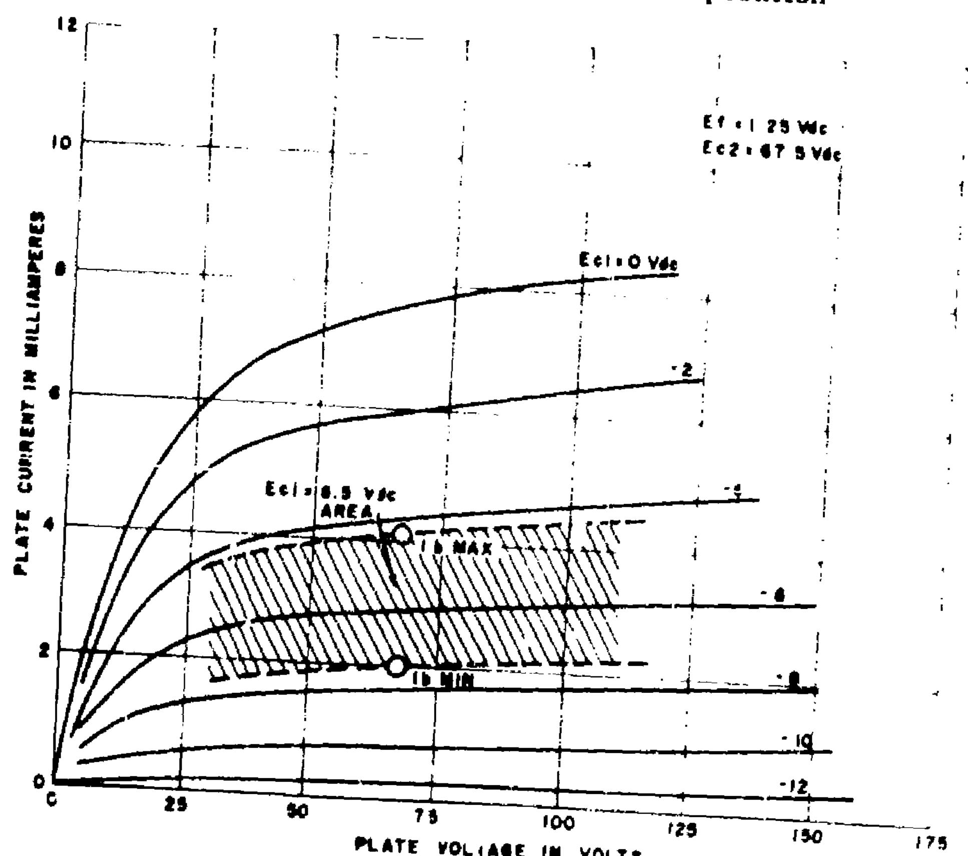


Figure 3-185. Limit Behavior of Tube Type JAN-5672 Static Plate Characteristics Data; Variability of Ib

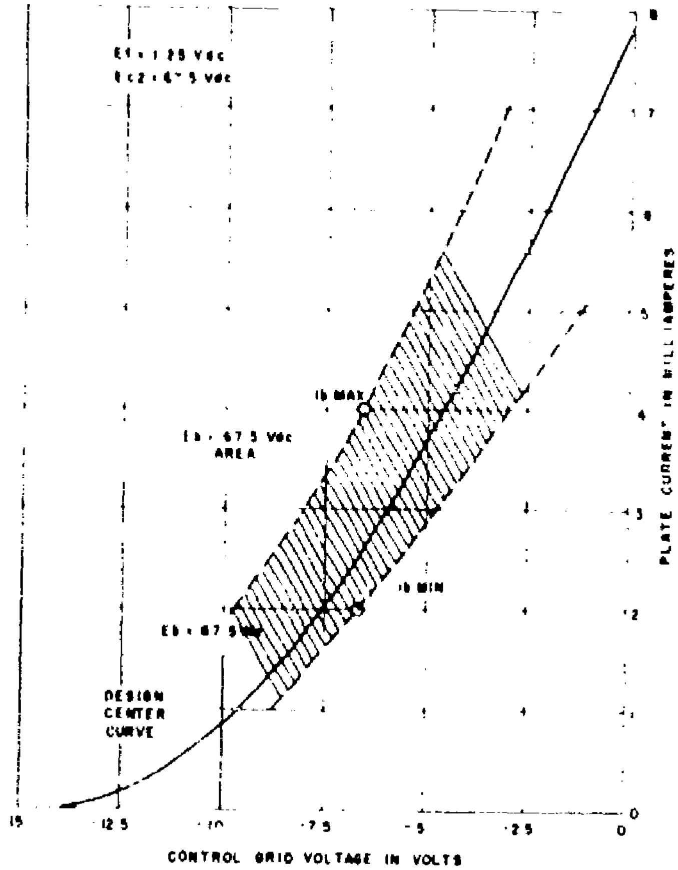


Figure 3-186. Limit Behavior of Tube Type JAN-5672 Transfer Data

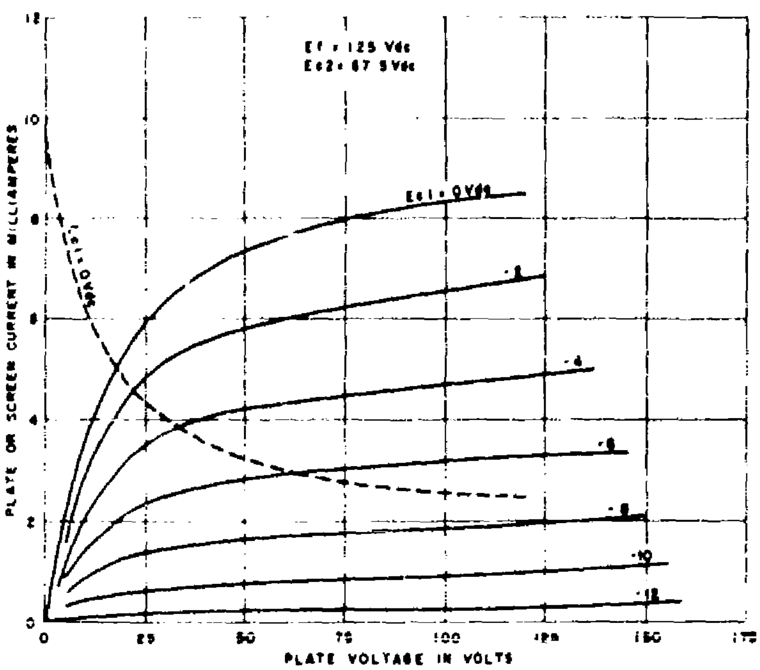


Figure 3-187. Typical Static Plate Characteristics of Tube Type JAN-5672

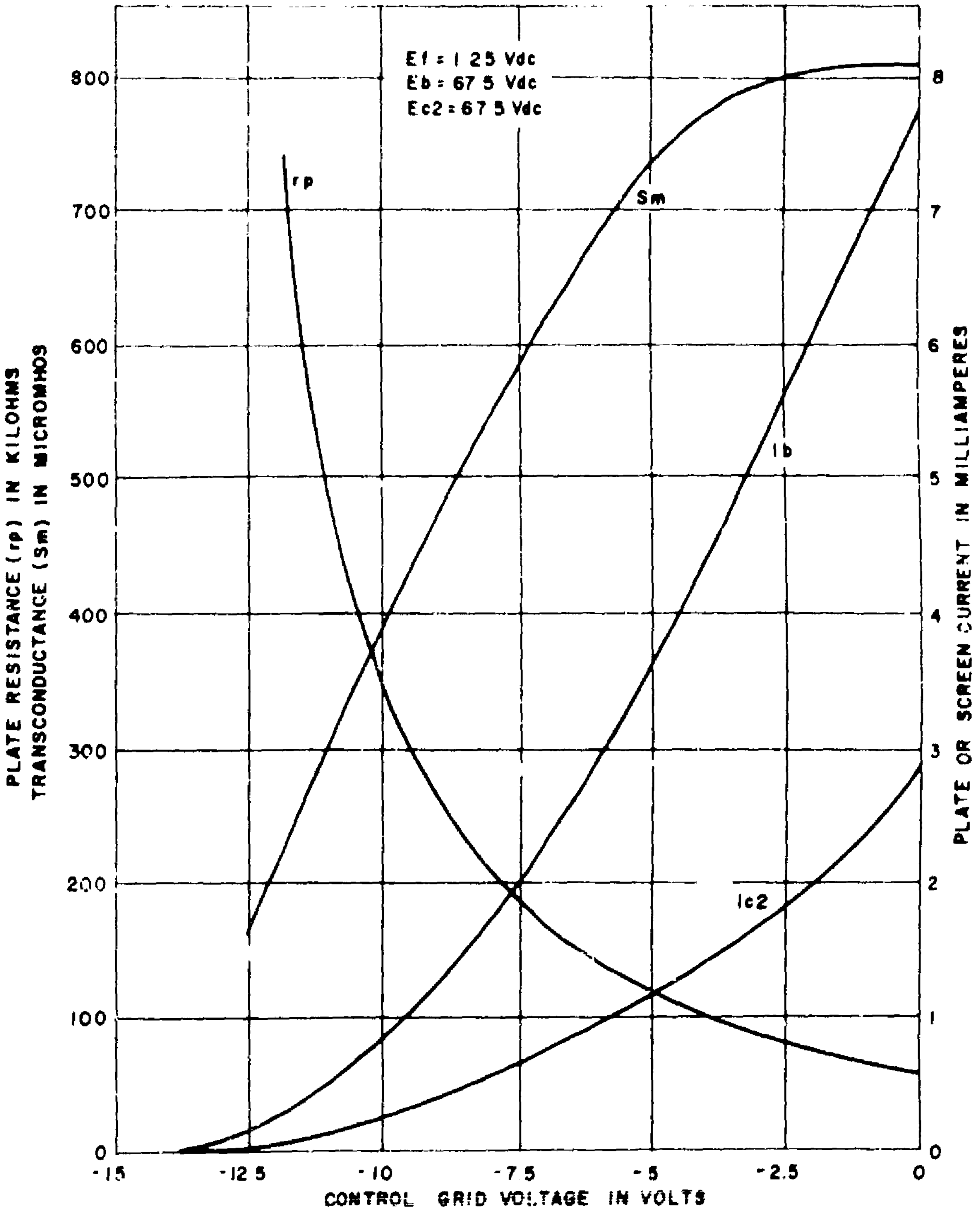


Figure 3-188. Typical JAN-5672 Characteristics; Sm, Rp, Ib and Ic2

SECTION 33

TUBE TYPE JAN-5686

3.33 DESCRIPTION

3.33.1 The JAN-5686 1/ is a 9-pin miniature, R-F beam power pentode having a transconductance in the range, 2600 to 4000 micromhos.

3.33.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Cathode . . . . Coated Unipotential

3.33.3 MOUNTING. Not specified.

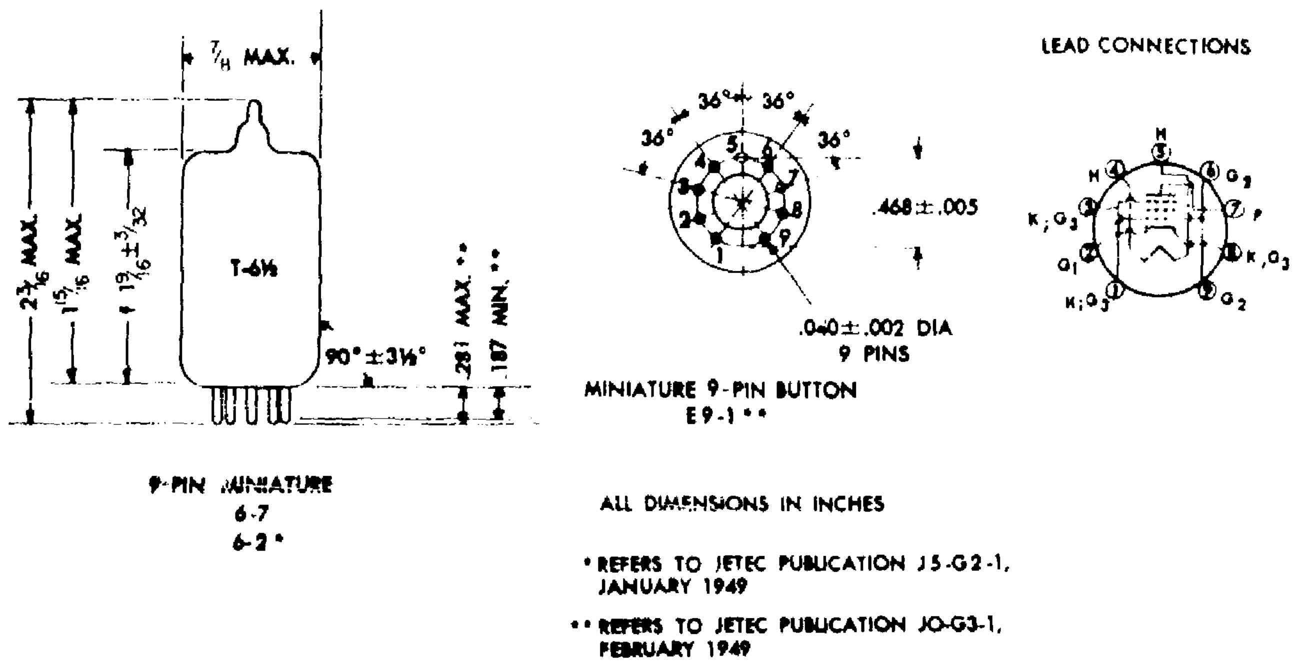


Figure 3-189. Outline Drawing and Base Diagram of Tube Type JAN-5686

1/ The values and specification comments presented in this section are related to MIL-E-1/171 dated 20 May 1953.

3.33.4 RATINGS, ABSOLUTE SYSTEM.

3.33.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 10%
* Plate Voltage	275 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
* Control Grid Voltage, Maximum	-165 Vdc
* Screen Grid Voltage	275 Vdc
Heater-Cathode Voltage	100 V
** Plate Current, Maximum	44 mAdc
Control Grid Current, Maximum	3.3 mAdc
* Plate Dissipation	8.25 W
* Screen Grid Dissipation	3.3 W
* Power Input (Plate)	11.0 W

3.33.6 TEST CONDITIONS.

3.33.7 Test conditions are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	250 Vdc
Control Grid Voltage, Ec1	-12.5 Vdc
Screen Grid Voltage, Ec2	250 Vdc

3.33.8 ACCEPTANCE TEST LIMITS.

3.33.9 Table 3-51 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/171 dated 20 May 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

3.33.10 APPLICATION.

3.33.11 Figure 3-190 shows the permissible operating area for JAN-5686 as defined by the ratings in MIL-E-1/171 dated 20 May 1953. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.33.12 Table 3-52 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

---

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-31. ACCEPTANCE TEST LIMITS OF JAN-5686

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		320	380	---	---	mA
Transconductance (1)	Sm		2600	4000	---	---	umhos
Plate Current (1)	Ib		21	35	---	---	mAdc
Screen Grid Current	Ic2		1.0	6.0	---	---	mAdc
Power Output	Po	Esig = 8.8 Vac Rp = 9000 ohms	2.2	---	---	---	W
Power Oscillation	Po	Esig adjusted fo Ic1 = 2 mAdc Ib = 40 mAdc Rc1=25,000 ohms F = 5 Mc	5.25	---	4.25	---	W
Capacitance	Cgp	Ef = 0	---	0.08	---	---	uuf
(Shielded as	Cin	Ef = 0	5.0	8.0	---	---	uuf
Specified)	Cout	Ef = 0	7.0	10.0	---	---	uuf
Control Grid Current	Ic1		0	-2.0	---	-2.0	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	0	40	---	---	uAdc
	Ihk	Ehk = -100 Vdc	0	-40	---	---	uAdc
Insulation of Electrodes							
R(g1-all)		Eg1-all= -100 Vdc	100	---	---	---	Meg
R(p-all)		Ep-all= -300 Vdc	100	---	---	---	Meg

3.33.13 SPECIAL OPERATING CONSIDERATIONS.

3.33.14 Current specification for this tube type provides a Class C power oscillation test at a frequency of 125 megacycles with initial limit on power output of 4.3 watts minimum under test conditions of Ec1 = -50 volts dc; and signal voltage such as to cause plate current of 40 mAdc. Life test end point, measured under these conditions is 4.25 watts minimum.

3.33.15 VARIABILITY OF CHARACTERISTICS.

3.33.16 The following charts show the extent of variability which may be expected

TABLE 3-52. APPLICATION PRECAUTIONS FOR JAN-5686

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.3
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.33.17 Figure 3-191 presents the limit behavior of static plate characteristics for JAN-5686 as defined by MIL-E-1/171 dated 20 May 1953.

3.33.18 Figure 3-192 presents the limit behavior of plate transfer data for JAN-5686 as defined by MIL-E-1/171 dated 20 May 1953.

3.33.19 DESIGN CENTER CHARACTERISTICS.

3.33.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.33.21 Figure 3-193 presents the static plate characteristics of JAN-5686.

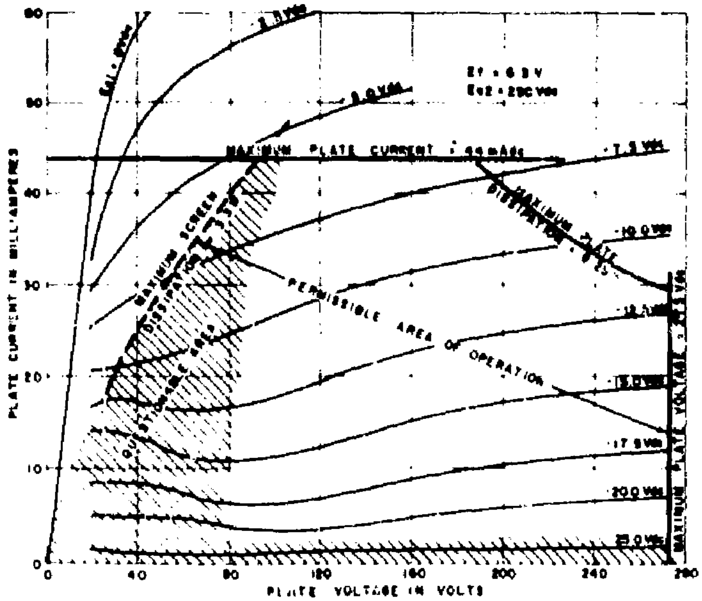


Figure 3-190. Typical Static Plate Characteristics of Tube Type JAN-5686; Permissible Area of Operation

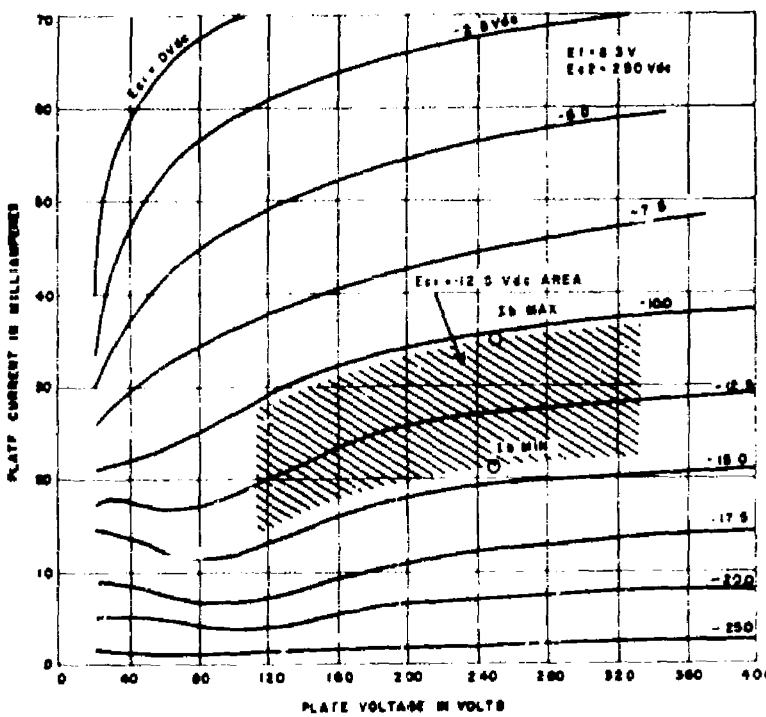


Figure 3-191. Limit Behavior of Tube Type JAN-5686 Static Plate Data; Variability of Ib

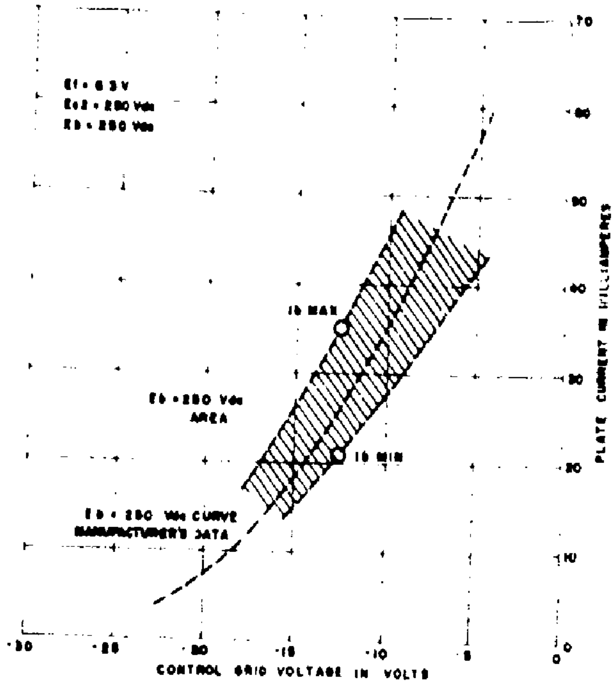


Figure 3-192. Limit Behavior of Tube Type JAN-5686 Transfer Data; Variability of Ib

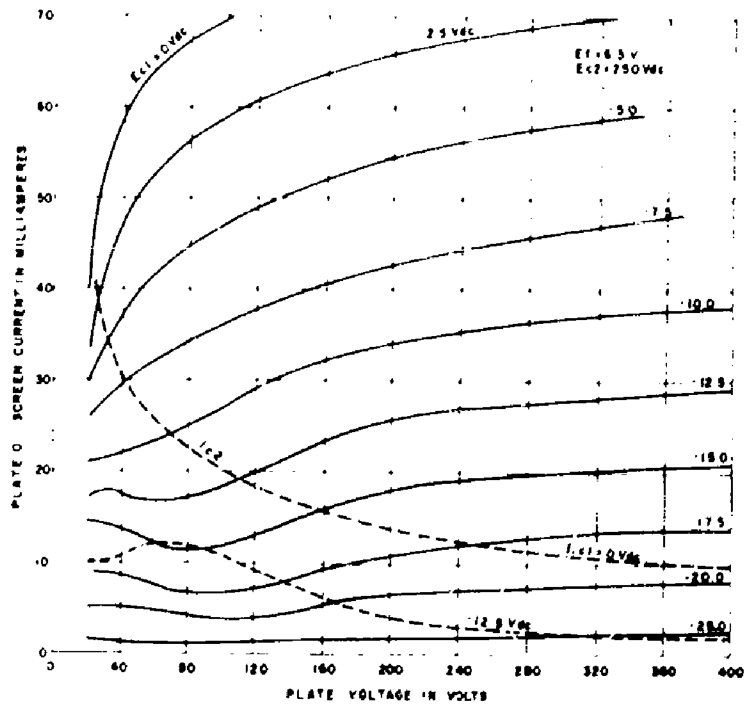


Figure 3-193. Typical Static Plate Characteristics of Tube Type JAN-5686

SECTION 34

TUBE TYPE JAN-5687

3.34 DESCRIPTION.

3.34.1 The JAN-5687 1/ is a 9 pin, miniature, general purpose twin triode having a Mu in the range of 15.0 to 20.5 and transconductance in the range 8000 to 14000 umhos. Each triode is electrically independent although the two heaters have a common connection.

3.34.2 ELECTRICAL. The electrical characteristics are as follows:

	Series	Parallel
Heater Voltage	6.3V	12.6V
Heater Current	.84-.96A	.42-.48 A
Cathode	Coated Unipotential	

3.34.3 MOUNTING. Not specified.

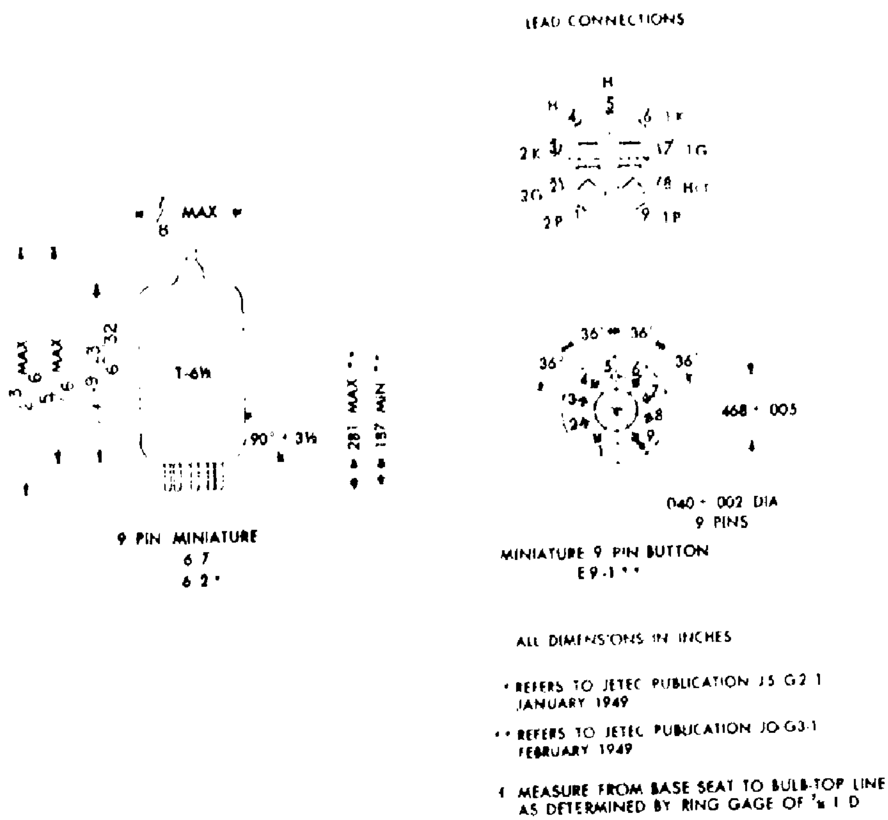


Figure 3-194. Outline Drawing and Base Diagram of Tube Type JAN-5687

1/ The values and specification comments presented in this section are related to MIL-E-1 80B dated 10 July 1954.

3.34.4 RATINGS, ABSOLUTE SYSTEM.

3.34.5 The absolute system ratings are as follows:

Heater Voltage	Series 12.6 ± 10%
	Parallel 6.3 ± 10%
Plate Voltage	330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Heater-Cathode Voltage	100 Vdc
** Cathode Current (each cathode)	65 mAdc
* Plate Dissipation (each plate) 2/	4.2 W
* Bulb Temperature	+ 200°C
* Altitude Rating	10,000 ft
Peak Plate Inverse Voltage	1000 v

3.34.6 TEST CONDITIONS.

3.34.7 Test conditions are as follows:

Heater Voltage, Ef	12.6 V
Plate Voltage, Eb	120 Vdc
Grid Voltage, Ec	-2.0 Vdc

3.34.8 ACCEPTANCE TEST LIMITS OF JAN-5687.

3.34.9 Table 3-53 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/80B dated 16 July 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.34.10 APPLICATION.

3.34.11 Figure 3-195 shows the permissible operating area for JAN-5687 as defined by the ratings in MIL-E-1/80B dated 16 July 1954. A discussion of the permissible operating area for triodes may be found in paragraphs 3.1.2 through 3.1.6.

---

* No test of operation at this rating exists in the specification.

** No specification assurance of life exists under conditions of cathode current approaching the maximum. Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

2/ Maximum total plate dissipation for both plates = 7.5 W.

TABLE 3-53. ACCEPTANCE TEST LIMITS OF JAN-5687

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If	Ef = 6.3 Vdc	0.84	0.96	- - -	- - -	A
Transconductance (1)	Sm		8000	14000	6000	- - -	umhos
Amplification Factor	Mu		15.0	20.5	- - -	- - -	
Plate Current (1)	Ib		27	45	22	- - -	mAdc
Plate Current (3)		Ec = -25 Vdc Eb = 300 Vdc	- - -	1.0	- - -	- - -	mAdc
Emission	Is	Eb = Ec = 15 Vdc	125	- - -	- - -	- - -	mAdc
Grid Current	Ic	Units in Parallel	0	-5.0	- - -	- - -	uAdc
Heater-Cathode Leakage	Ihk		0	30	- - -	- - -	uAdc

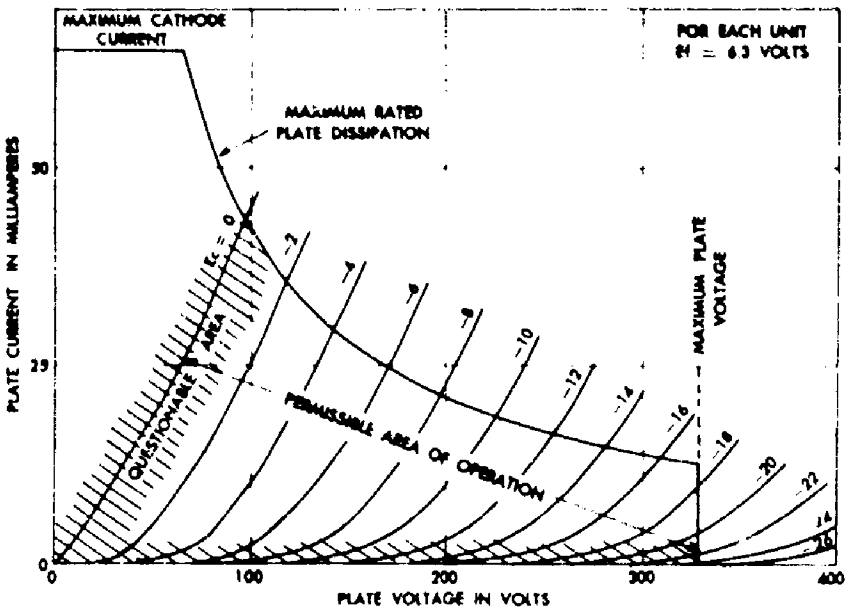


Figure 3-195. Typical Plate Characteristics of JAN-5687; Permissible Area of Operation.

3.34.12 Table 3-54 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-54. APPLICATION PRECAUTIONS FOR JAN-5687

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
- High, 3.1.8
- Low, 3.1.15
- AC Operation, 1.3.20, 3.1.10
- 28 Volt, 3.1.15

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.1.3
- Cathode, 2.1.3, 3.1.12
- Fixed, 1.3.8, 2.1.3, 3.1.4

Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19

Resistance (Cont.)

1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 3.1.3 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Gid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28

Current (Cont.)

Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3..16

3.34.13 VARIABILITY OF CHARACTERISTICS.

3.34.14 The following charts show the variability which may be expected between individual tubes. The boundaries of this variability were determined from the acceptance limits given on the specification.

3.34.15 Figure 3-196 presents the limit behavior of transfer plate characteristics for JAN-5687 as defined by MIL-E-1/80B dated 16 July 1954.

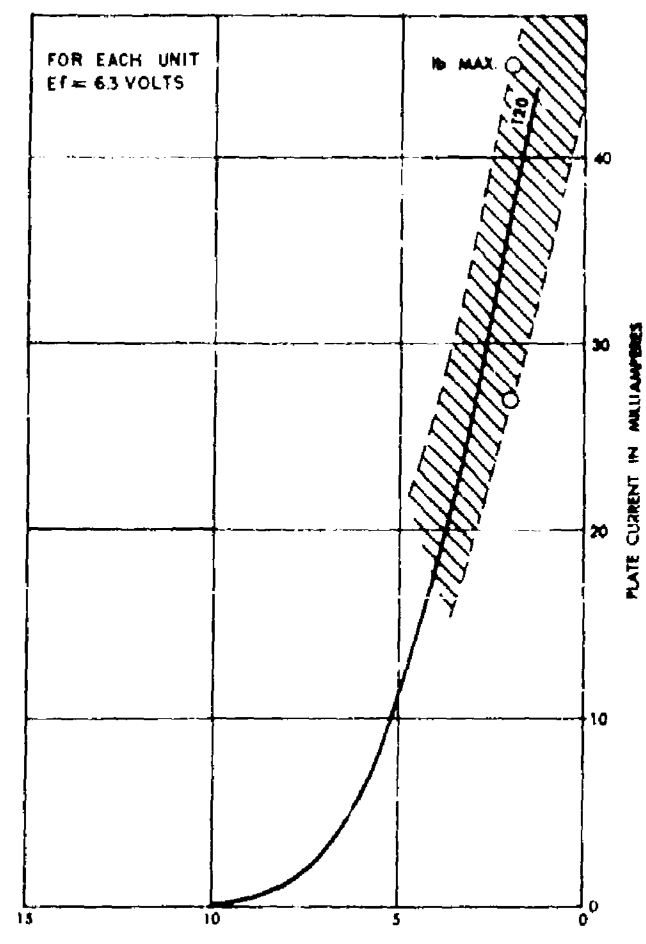


Figure 3-196. Limit Transfer Characteristics of JAN-5687

3.34.16 **Figure 3-197 presents the limit behavior of static plate data for JAN-5687 as defined by MIL-E-1/80B dated 16 July 1954.**

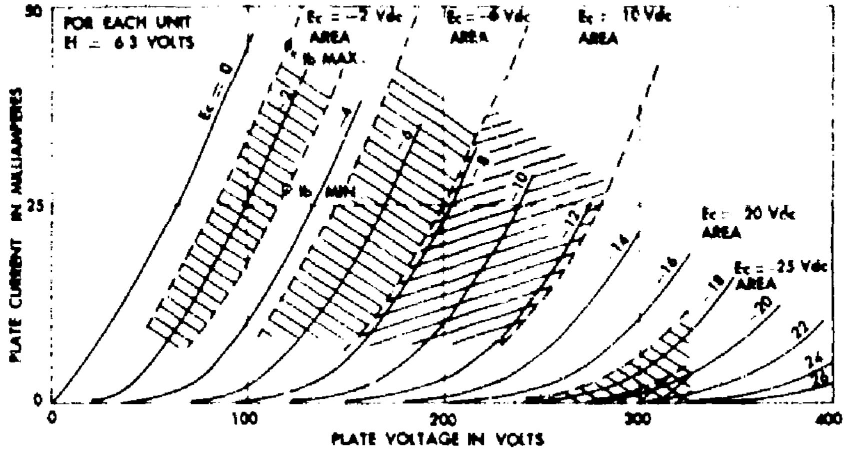


Figure 3-197. Limit Plate Characteristics of JAN-5687

3.34.17 DESIGN CENTER CHARACTERISTICS.

3.34.18 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.34.19 Figure 3-198 presents the Static Plate and Grid Characteristics of JAN-5687 for the positive grid region.

Caution: Operation defined by this chart is not supported by any specification test rating.

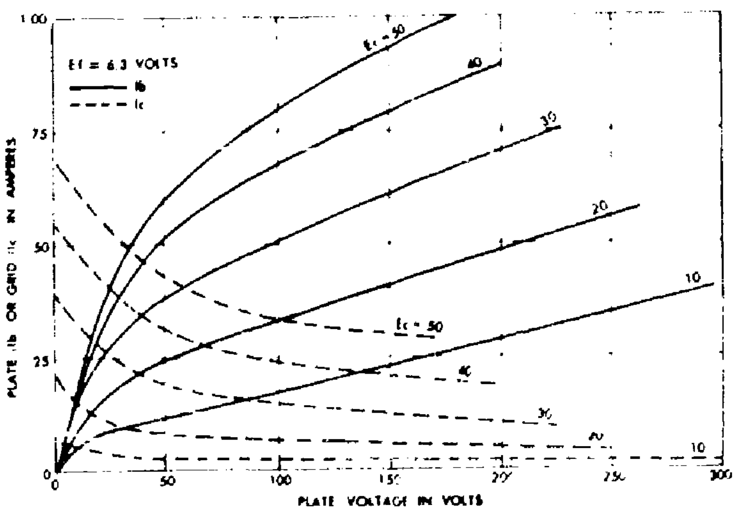


Figure 3-198. Typical Plate and Grid Characteristics of JAN-5687

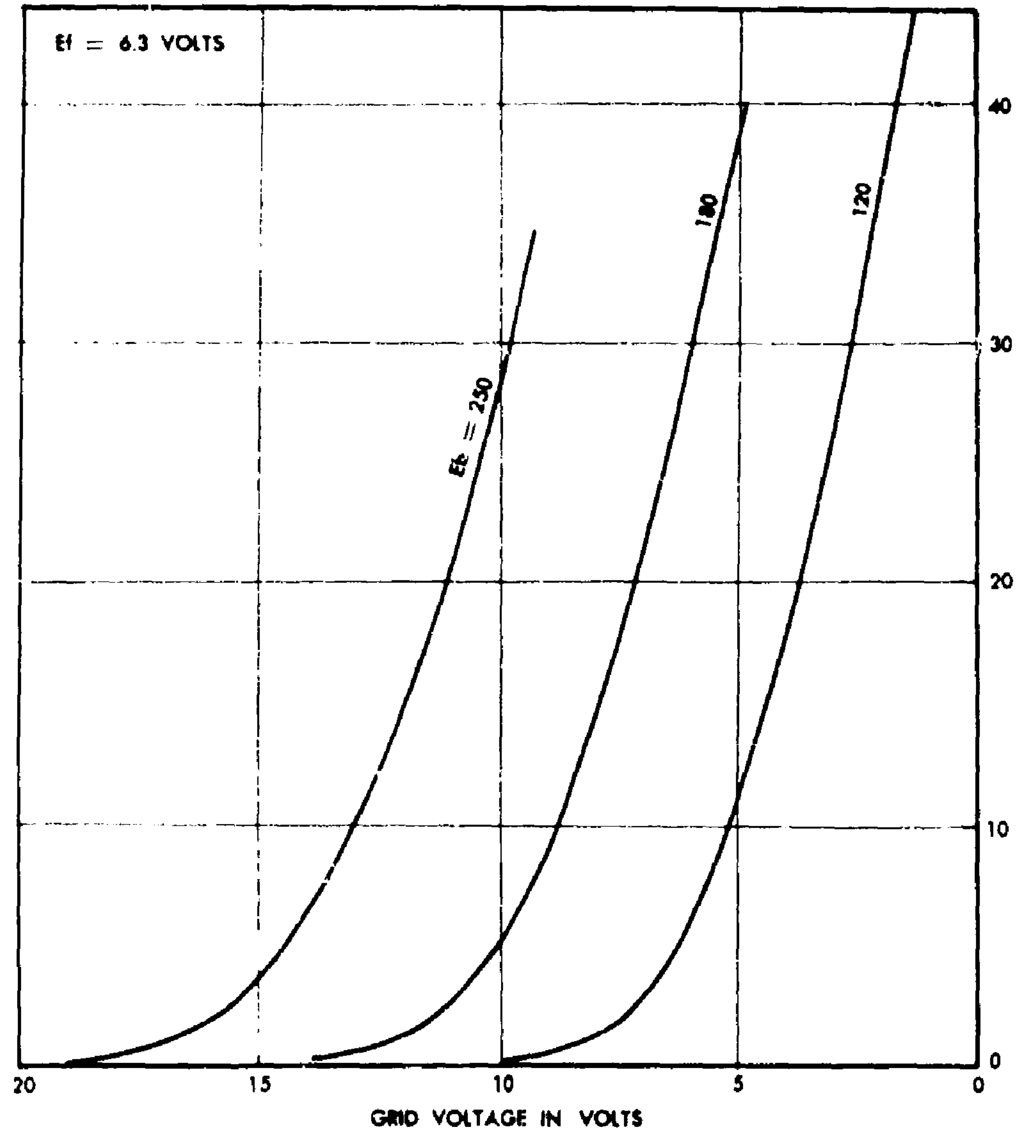


Figure 3-199. Typical Transfer Characteristics of JAN-5687

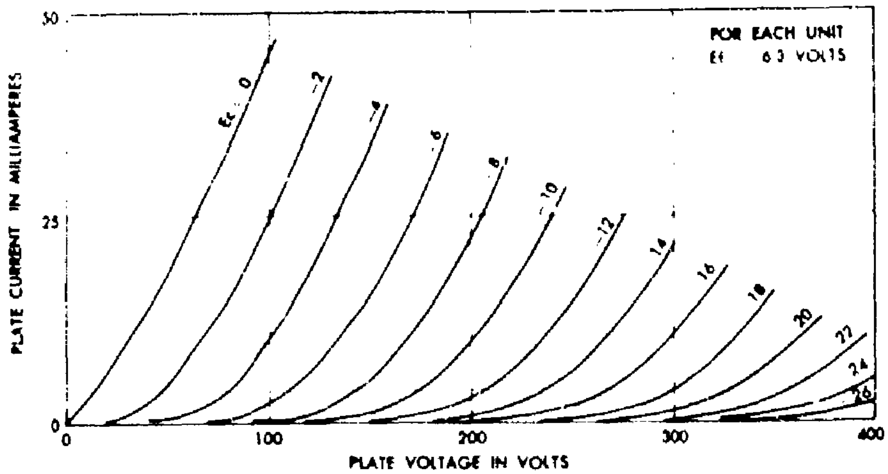


Figure 3-200. Typical Plate Characteristics of JAN-5687

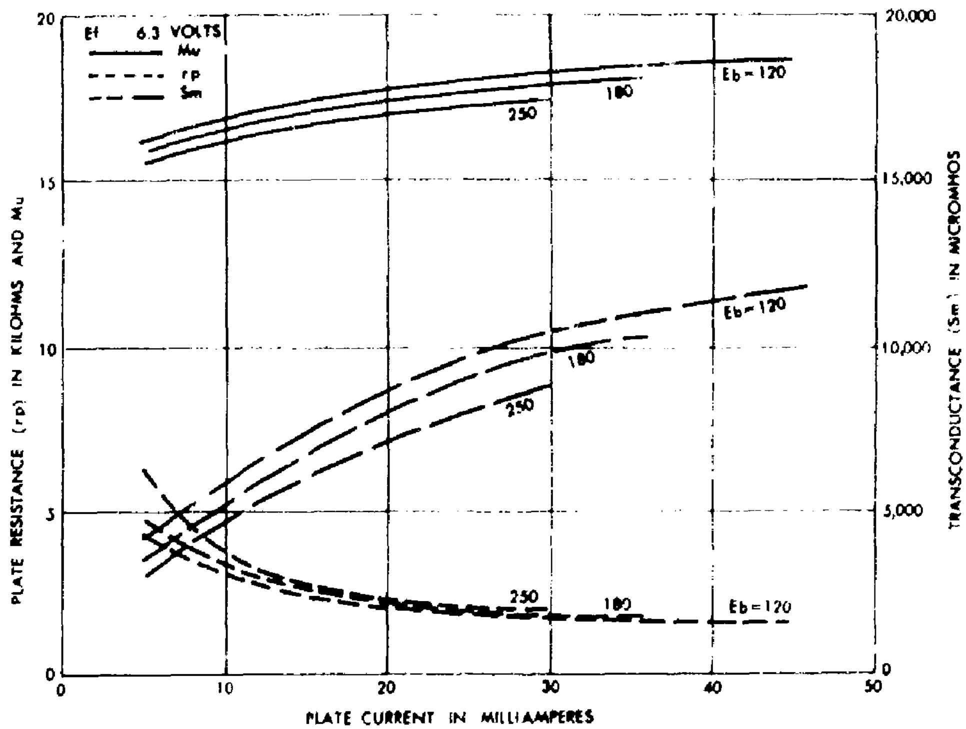


Figure 3-201. Typical JAN-5687 Characteristics; Variability of Sm, Mu and Rp

SECTION 35

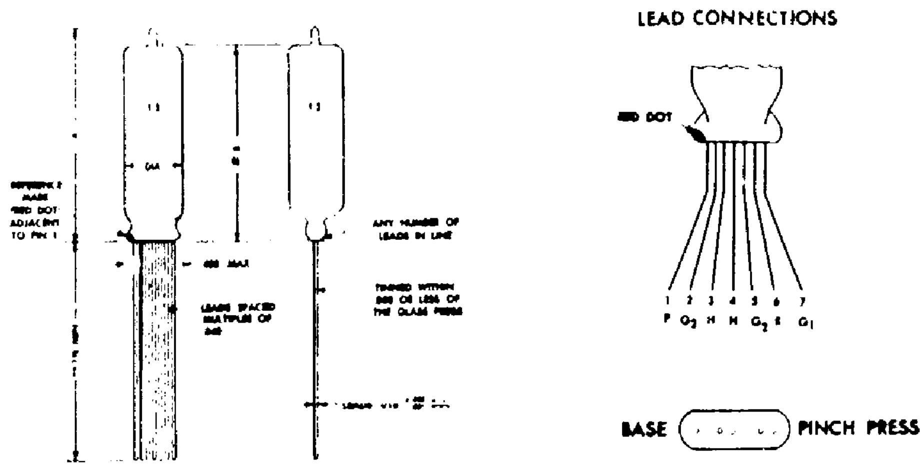
TUBE TYPE JAN-5702WA

3.35 DESCRIPTION.

3.35.1 The JAN-5702WA 1/ is a 7-lead, pinch press, subminiature, sharp-cutoff pentode having a design center transconductance of 5000 micromhos. The JAN-5702WA is similar in plate characteristics to JAN-5840 and the miniature type JAN-5654/6AK5W.

3.35.2 ELECTRICAL. The electrical characteristics are as follows:
Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . .200 mA
Cathode . . . . Coated Unipotential

3.35.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX
	DIM	TOL. ±	
1.500	1.250	.100	.400

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-202. Outline Drawing and Base Diagram of Tube Type JAN-5702WA

1/ The values and specification comments presented in this section are related to MIL-E-1/82A dated 28 October 1953.

3.35.4 RATINGS, ABSOLUTE SYSTEM.

3.35.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.6 V
Plate Voltage	200 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Screen Voltage	155 Vdc
* Control Grid Voltage, Minimum	-55 Vdc
Suppressor Grid Voltage, Maximum	0 Vdc
* Plate Dissipation	1.85 W
* Screen Dissipation	.55 W
Heater-Cathode Voltage	200 v
** Cathode Current, Maximum	20 mAdc
** Cathode Current, Minimum	0.5 mAdc
* Bulb Temperature	265° C
* Altitude Rating	60,000 ft

3.35.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.35.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	120 Vdc
Screen Grid Voltage, Ec2	120 Vdc
Suppressor Grid Voltage, Ec3	0 Vdc
Cathode Resistance, Rk	200 ohms
Heater Current, If	200 mA
Plate Current, Ib	7.5 mAdc
Screen Grid Current, Ic2	2.0 mAdc
Transconductance, Sm	5000 umhos

3.35.8 ACCEPTANCE TEST LIMITS.

3.35.9 Table 3-55 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/82A dated 28 October 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions and Design Center Characteristics, unless otherwis indicated.

---

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-55. ACCEPTANCE TEST LIMITS OF JAN-5702WA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		183	217	183	217	mA
Transconductance (1)	Sm		4200	5800	---	---	umhos
Change in individual	Δ Sm t		---	---	---	25	%
Plate Resistance	rp		.15	---	---	---	Meg
Plate Current (1)	Ib		5.5	9.5	---	---	mAdc
Screen Grid Current	Ic2		1.7	3.5	---	---	mAdc
Capacitance	Cgl-p	Ef = 0	---	0.03	---	---	uuf
(Shielded as	Cin	Ef = 0	3.6	5.1	---	---	uuf
Specified)	Cout	Ef = 0	2.6	3.7	---	---	uuf
Control Grid Current	Ic1		0	-0.1	0	-0.3	uAdc
Heater-Cathode Leakage							
	Ihk	Ehk = +100 Vdc	---	7	---	10	uAdc
	Ihk	Ehk = -100 Vdc	---	-7	---	-10	uAdc
Insulation of Electrodes							
	R(gl-all)	Egl-all= -100 Vdc	100	---	50	---	Meg
	R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

3.35.10 APPLICATION.

3.35.11 Figure 3-203 shows the permissible operating area for JAN-5702WA as defined by the ratings in MIL-E-1/82A dated 28 October 1953. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.35.12 Table 3-56 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

3.35.13 VARIABILITY OF CHARACTERISTICS.

3.35.14 The following charts show the variability which may be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

TABLE 3-56. APPLICATION PRECAUTIONS FOR JAN-5702WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
 High, 3.2.12
 Low, 3.2.3, 3.2.7
 28 Volt, 3.2.21
 AC Operation, 1.3.20, 3.2.18
Screen Grid:
 Supply, 3.2.8
 Protection, 3.2.22
Control Brid Bias:
 Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
 Cathode, 2.1.3, 3.2.15
 Fixed, 1.3.8, 2.1.3, 3.?.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.35.15 Figure 3-204 presents the limit behavior of static plate characteristics for JAN-5702WA as defined by MIL-E-1/82A dated 28 October 1953.

3.35.16 Figure 3-205 presents the limit behavior of static screen grid characteristics for JAN-5702WA.

3.35.17 Figure 3-206 presents the limit behavior of plate transfer data for JAN-5702WA as defined by MIL-E-1/82A dated 28 October 1953.

3.35.18 Figures 3 207 and 3-208 present the limit behavior of screen grid transfer data for JAN-5702WA.

3.35.19 DESIGN CENTER CHARACTERISTICS.

3.35.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.35.21 **Figure 3-209 presents the static plate characteristics of JAN-5702WA.**

3.35.22 **Figure 3-210 presents the typical plate transfer data for JAN-5702WA.**

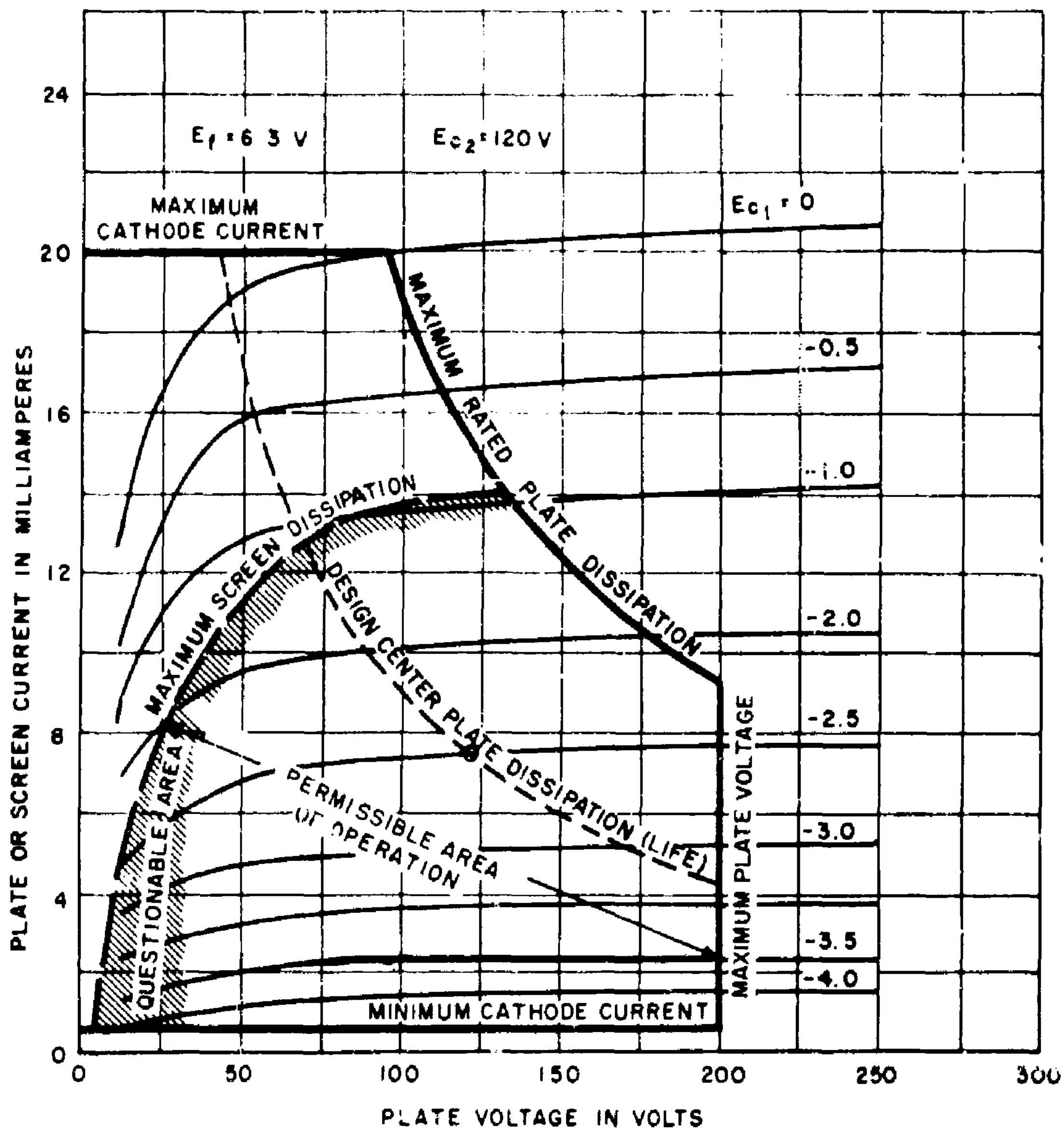


Figure 3-203. Typical Static Plate Characteristics of Tube Type JAN-5702WA; Permissible Area of Operation

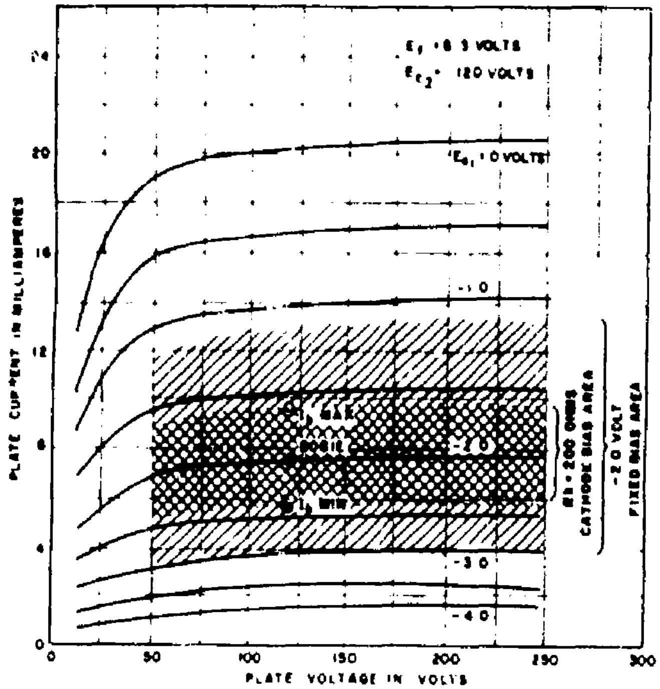


Figure 3-204. Limit Behavior of Tube Type JAN-5702WA Static Plate Data; Variability of Ib

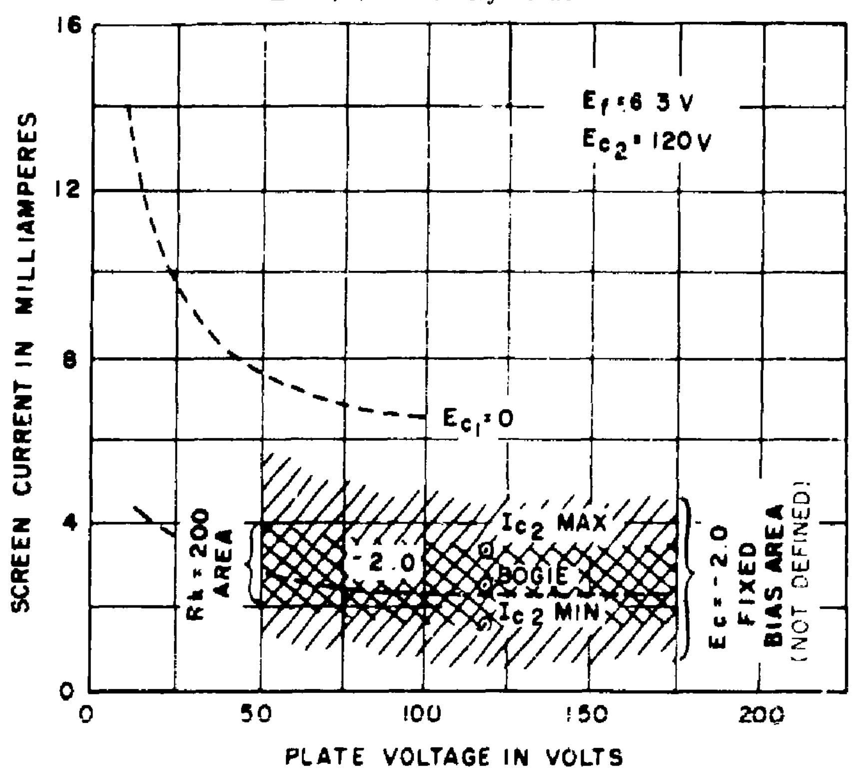


Figure 3-205. Limit Behavior of Tube Type JAN-5702WA Static Screen Data; Variability of Ic2

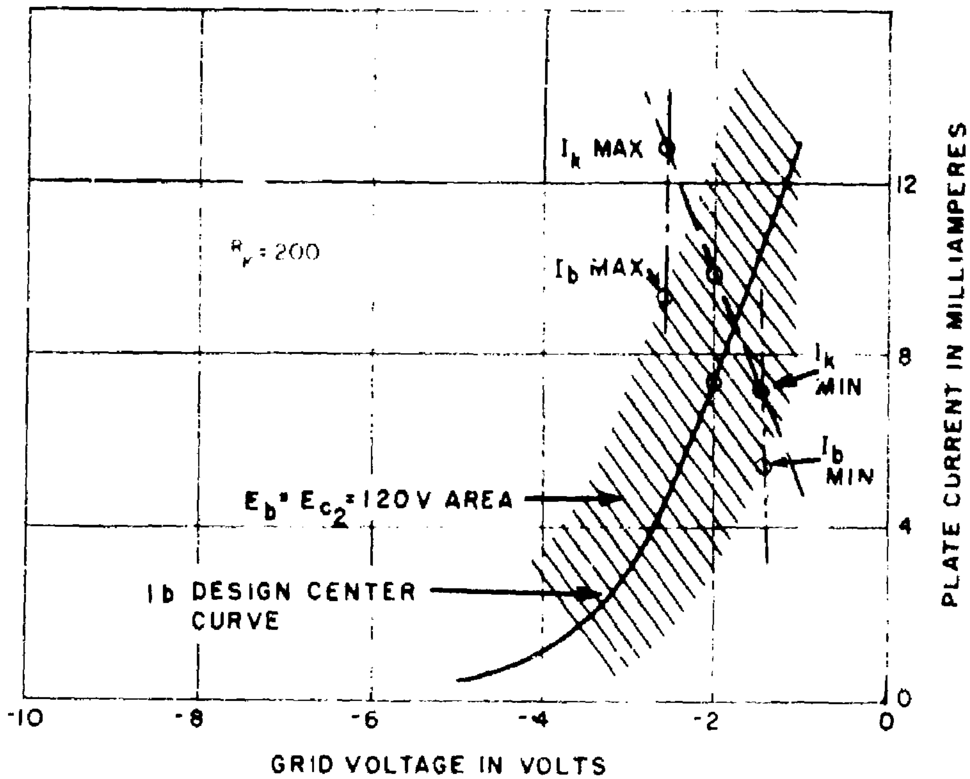


Figure 3-206. Limit Behavior of Tube Type JAN-5702WA Transfer Data; Variability of Ib

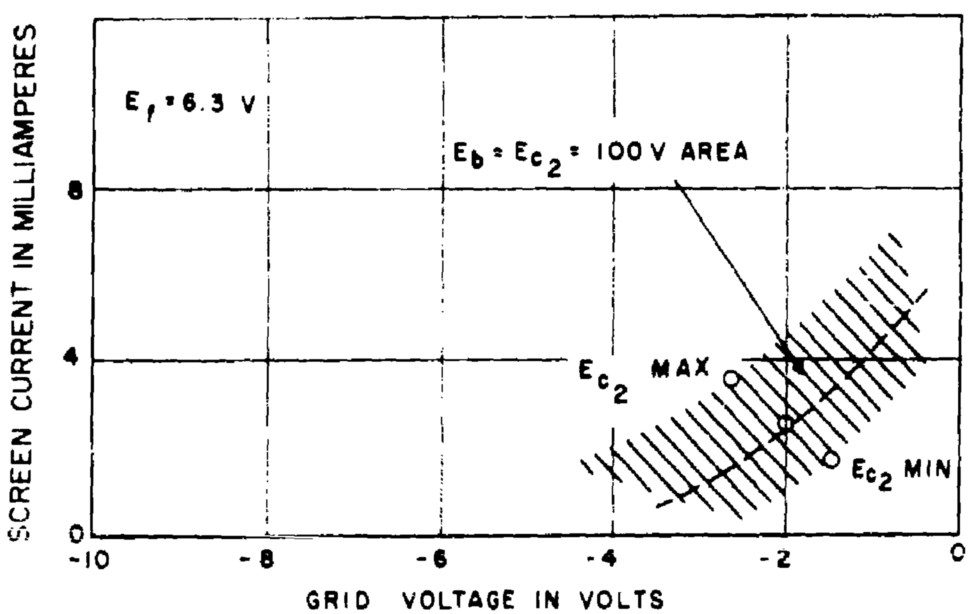


Figure 3-207. Tube Type JAN-5702WA Limit Behavior, Variability of Ic2

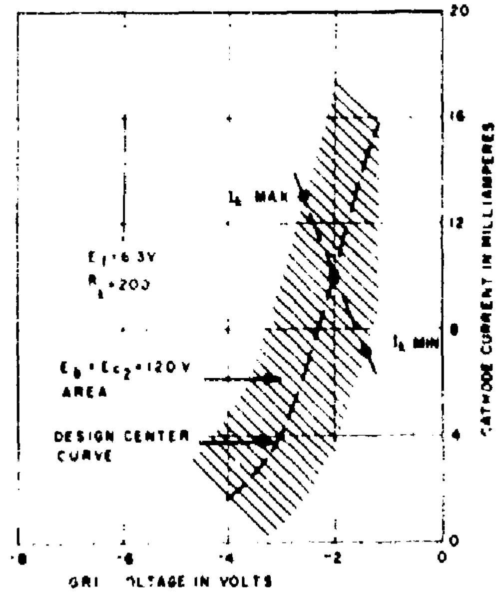


Figure 3-208. Limit Behavior of Tube Type JAN-5702WA Transfer Data; Variability of Ik

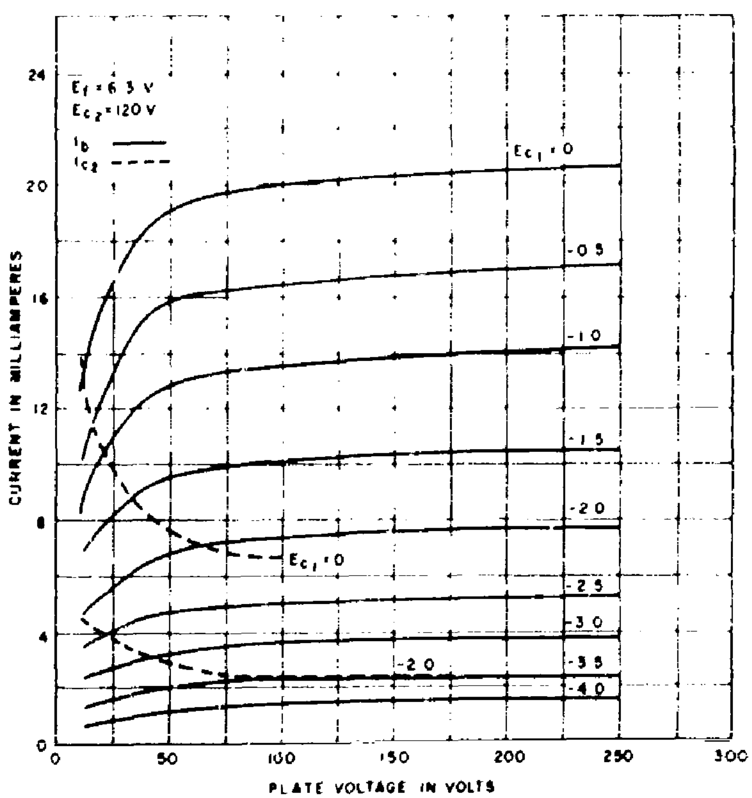


Figure 3-209. Typical Static Plate Characteristics of Tube Type JAN-5702WA

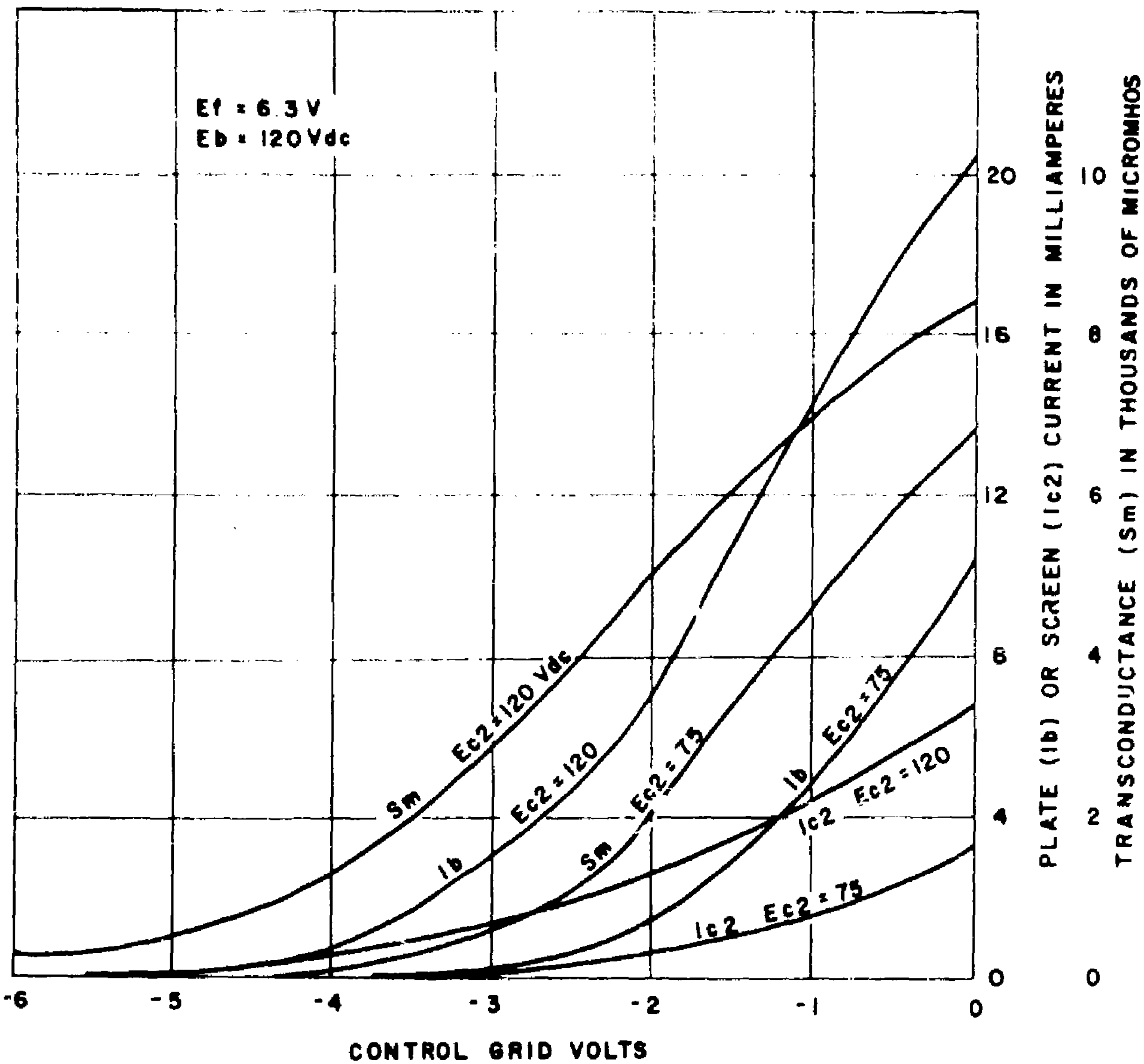


Figure 3-210. Typical Transfer Data for Tube Type JAN-5702WA

SECTION 36

TUBE TYPE JAN-5703WA

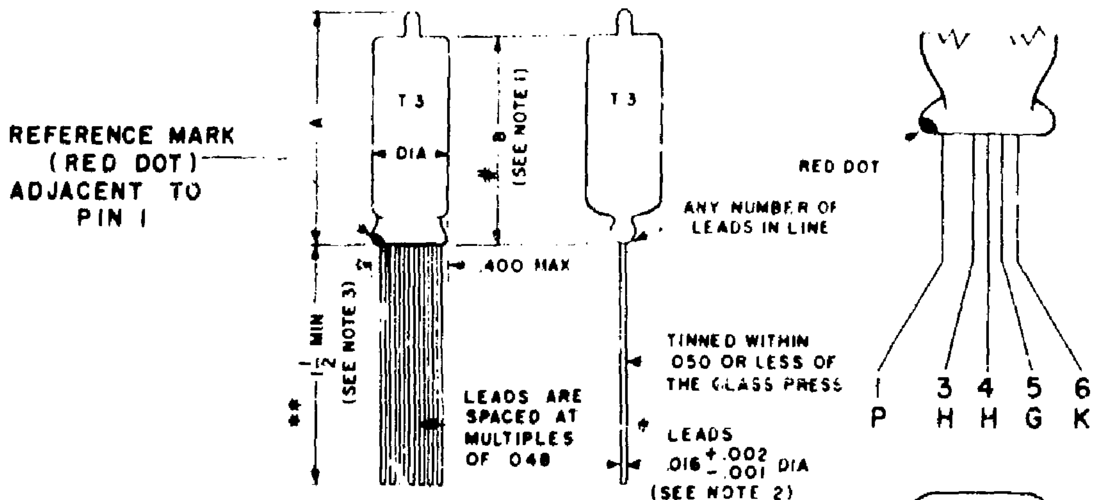
3.36 DESCRIPTION.

3.36.1 The JAN-5703WA [1/] is a 5-lead, pinch-press subminiature triode having a design center Mu of 25.5 and transconductance of 5000. The JAN-5703WA is similar in plate characteristics to the JAN-5718 and the ˜ N-6111. The JAN-5703WA has given satisfactory service in a variety of applica ι including oscillator circuits at 500 mc.

3.36.2 **ELECTRICAL.** The electrical characteristics are as follows:

Heater Voltage .... 6.3 V
Heater Current, Design Center .... 200 mA
Cathode .... Coated Unipotential

3.36.3 **MOUNTING.** Not specified.



DIMENSIONS			
A MAX.	B DIM	B TOL. ±	DIAMETER MAX
1.500	1.250	.100	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 + .001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER

Figure 3-211. Outline Drawing and Base Diagram of Tube Type JAN-5703WA

[1/] The values and specification comments presented in this section are related to MIL-E-1/293A, dated 16 July 1954.

3.36.4 RATINGS, ABSOLUTE SYSTEM.

3.36.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.6 V
Plate Voltage Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	275 V
*Plate Dissipation	3.3 W
*Heater-Cathode Voltage	200 v
**Plate Current	22 mAdc
*Grid Current	5.5 mAdc
*Bulb Temperature	+265° C
Altitude Rating	60,000 ft

3.36.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.36.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	120 Vdc
Grid Voltage, Ec	0 Vdc
Heater-Cathode Voltage, Ehk	0 Vdc
Cathode Resistance, Rk	220 ohms
Heater Current, If	200 mA
Plate Current, Ib	9.4 mAdc
Transconductance, Sm	5000 umhos
Amplification Factor, Mu	25.5

3.36.8 ACCEPTANCE TEST LIMITS.

3.36.9 Table 3-58 summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/293A dated 16 July 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.36.10 APPLICATION.

3.36.11 Figure 3-212 shows the permissible operating area for JAN-5703WA as defined by the ratings in MIL-E-1/293A dated 16 July 1954. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

---

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-57. ACCEPTANCE TEST LIMITS OF JAN-5703WA

PROPERTY	MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIMITS LIFE TEST MIN	LIMITS LIFE TEST MAX	UNITS
Heater Current If		183	217	183	217	mA
Transconductance (1) Sm		4200	5800	---	---	umhos
Change in individual $\Delta \frac{Sm}{t}$		---	---	---	25	%
Amplification Factor Mu		21	30	---	---	---
Plate Current (1) Ib		6.8	12.0	---	---	mAdc
Plate Current (2) Ib	Ec = -8.5 Vdc	---	50	---	---	uAdc
Power Oscillation Po	F = 500 Mc; Eb=150 Vdc Rg/Ib=20 mAdc	600	---	---	---	mW
Capacitance Cgp	Ef = 0	.9	1.6	---	---	uuf
(Without Cin	Ef = 0	2.0	3.2	---	---	uuf
Shield) Cout	Ef = 0	.5	.9	---	---	uuf
Grid Current (1) Ic		0	-0.3	0	-0.6	uAdc
Grid Current (2) Ic	Ef= 7.0 V, measure after 5 min.	0	-0.3	0	-1.0	uAdc
Heater-Cathode Leakage Ihk	Ehk = +100	---	10	---	30	uAdc
Ihk	Ehk = -100	---	-10	---	-30	uAdc
Insulation of Electrodes R(g-all)	Eg-all = -100 Vdc	100	---	50	---	Meg
R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

3.36.12 Table 3-58 lists general considerations for the application of this type. The numbers refer to the applicable paragraphs of this Manual.

3.16.13 In addition to the general consideration referenced in Table 3-58, the JAN-5703WA, as specified by MIL-E-1/239A, has additional assurance, initially at least, of radio frequency operation by an acceptance test of oscillation at 500 mc.

TABLE 3-58. APPLICATION PRECAUTIONS FOR JAN-5703WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27
  1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
  High, 3.1.8
  Low, 3.1.15
  AC Operation, 1.3.20, 3.1.10
  28 Volt, 3.1.15
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.1.3
  Cathode, 2.1.3, 3.1.12
  Fixed, 1.3.8, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.5

Resistance

Control Grid Series, 1.3.9, 1.3.19
  1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50. 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35,
  2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control, Grid, 1.3.4, 1.3.9, 1.3.23,
  3.1.3
Plate, low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.36.14 VARIABILITY OF CHARACTERISTICS.

3.36.15 The following charts show the variation which may be expected among individual tubes. The boundaries of this variability were determined from the acceptance limits given on the specification.

3.36.16 Figure 3-213 presents the limit behavior of static plate characteristics for JAN-5703WA as defined by MIL-E-1/293A dated 16 July 1954.

3.36.17 Figure 3-214 presents the limit behavior of plate transfer data for JAN-5703WA as defined by MIL-E-1/293A dated 16 July 1954.

3.36.18 DESIGN CENTER CHARACTERISTICS.

3.36.19 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.36.20 Figure 3-215 presents the static plate characteristics of JAN-5703WA.

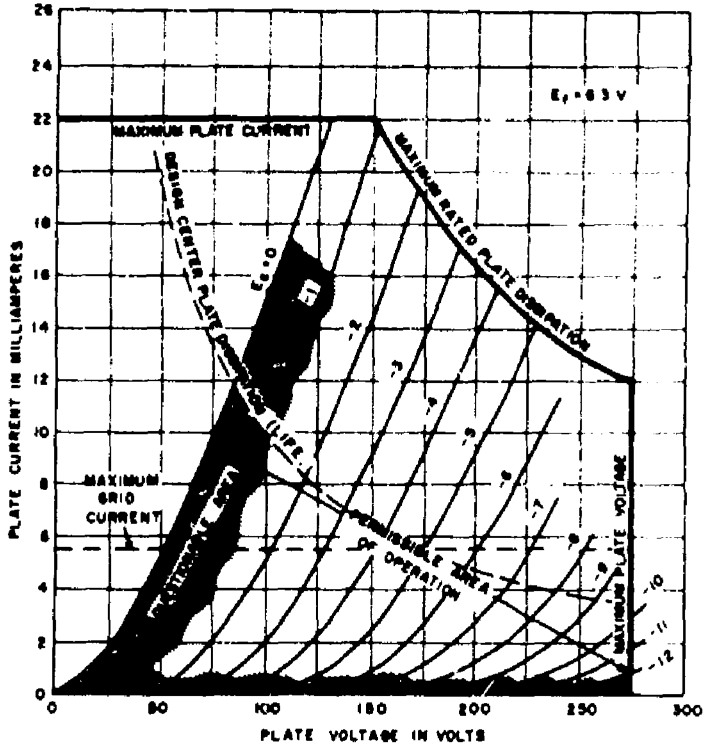


Figure 3-212. Typical Static Plate Characteristics of Tube Type JAN-5703WA; Permissible Area of Operation

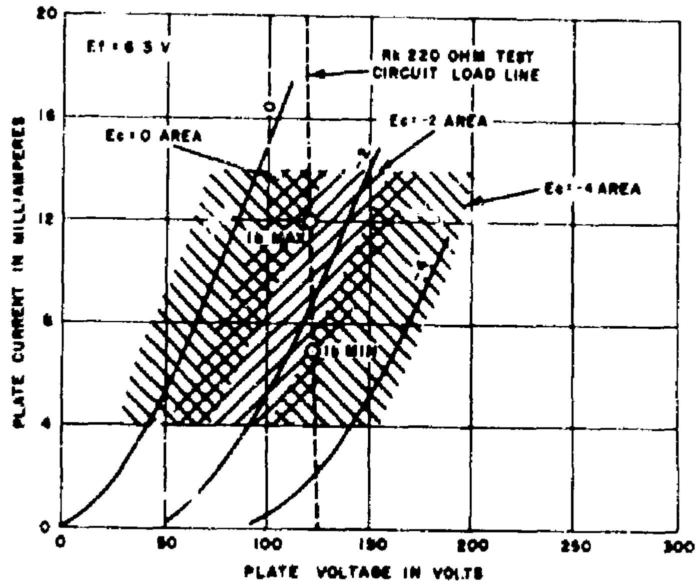


Figure 3-213. Limit Behavior of Tube Type JAN-5703WA Static Plate Data; Variability of Ib

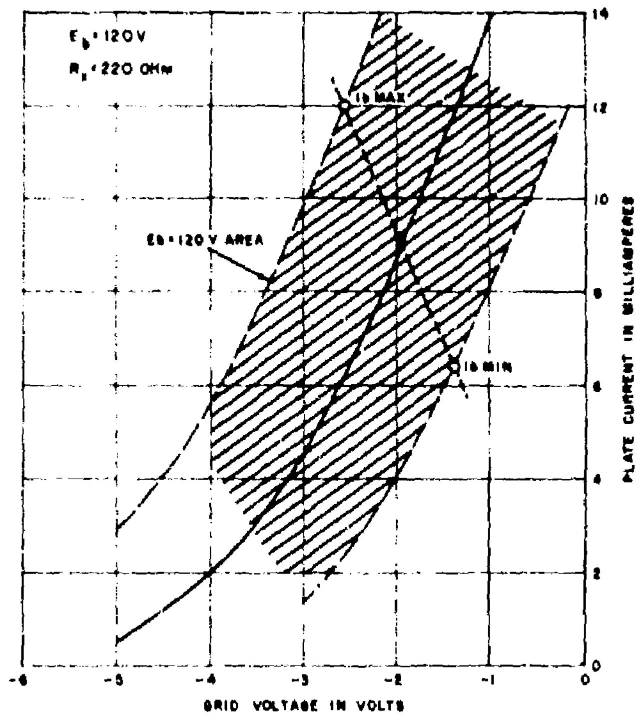


Figure 3-214. Limit Behavior of Tube Type JAN-5703WA Transfer Data

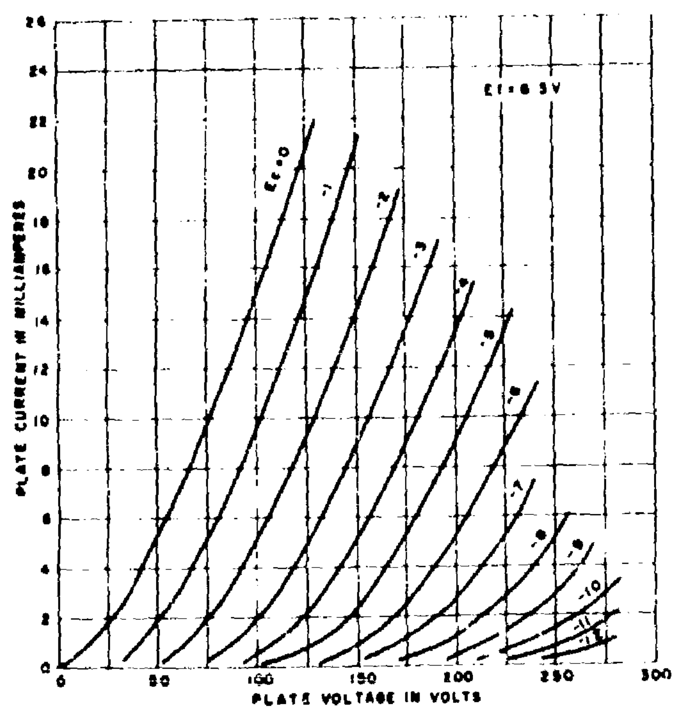


Figure 3-215. Typical Static Plate Characteristics of Tube Type JAN-5703WA

SECTION 37

TUBE TYPE JAN-5718

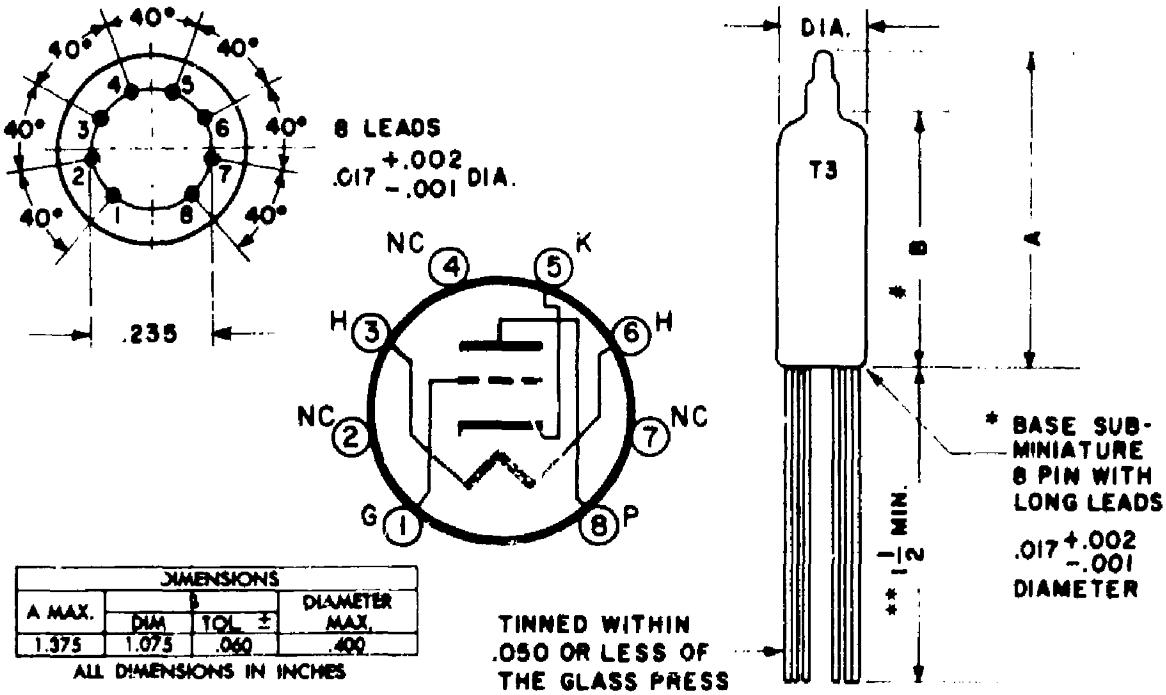
3.37 DESCRIPTION.

3.37.1 The JAN-5718 [1] is an 8-lead, button-base subminiature triode having a Mu in the range of 23 to 31 and design center transconductance of 5800. The JAN-5718 is similar in plate characteristics to the JAN-5897. Each of these types has found satisfactory service in amplifier, 500-mc-oscillator, and other general-purpose triode applications.

3.37.2 **ELECTRICAL.** The electrical characteristics are as follows:

Heater Voltage .... 6.3 V
Heater Current, Design Center .... 150 mA
Cathode .... Coated Unipotential

3.37.3 **MOUNTING.** Not specified.



DIMENSIONS			
A MAX.	B DIM	B TOL. ±	DIAMETER MAX.
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-216. Outline Drawing and Base Diagram of Tube Type JAN-5718

[1] The values and specification comments presented in this section are related to MIL-E-172/B dated 5 August 1955.

3.37.4 RATINGS, ABSOLUTE SYSTEM.

3.37.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Grid Voltage, Maximum	0 Vdc
Grid Voltage, Minimum	-55 Vdc
Heater-Cathode Voltage	200 v
Grid Series Resistance	1.2 Meg
**Plate Current	22.0 mAdc
*Grid Current	5.5 mAdc
Plate Dissipation	0.9 W
Bulb Temperature	+220° C
Altitude Rating	60,000 ft

3.37.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.37.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Grid Voltage, Ec	0 Vdc
Heater-Cathode Voltage, Ehk	0 v
Cathode Resistance, Rk	150 ohms
Heater Current, If	150 mA
Plate Current, Ib	8.5 mAdc
Transconductance, Sm	5800 umhos

3.37.8 ACCEPTANCE TEST LIMITS.

3.37.9 Table 3-59 summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/172B dated 5 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.37.10 APPLICATION.

3.37.11 Figure 3-217 shows the permissible operating area for JAN-5718 as defined by the ratings in MIL-E-1/172B dated 5 August 1955. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-59. ACCEPTANCE TEST LIMITS OF JAN-5718

PROPERTY	MEASUREMENT CONDITIONS	LIMITS				UNITS
		INITIAL		LIFE TEST		
		MIN	MAX	MIN	MAX	
Heater Current If		140	160	138	164	mA
Transconductance (1) Sm		4800	6800	---	---	umhos
Change in individual Δ_t Sm		---	---	---	20	%
Amplification Factor Mu		23	31	---	---	---
Plate Current (1) Ib		6.0	11.0	---	---	mAdc
Plate Current (2) Ib	Ec = -7.0 Vdc Rk = 0	---	100	---	---	uAdc
Plate Current (3) Ib	Ec = -4.0 Vdc Rk = 0	20	---	---	---	uAdc
Power Oscillation Po	F = 500 Mc; Eb=150 Vdc Rg/Ib=20 mAdc	600	---	---	---	mW
Capacitance Cgp	Ef = 0	1.1	1.8	---	---	uuf
(Without Cin	Ef = 0	1.6	2.8	---	---	uuf
Shield) Cout	Ef = 0	0.5	0.9	---	---	uuf
Grid Current Ic	Eb=150 Vdc, Rk=380 ohms Rg=1.0 Meg	0	-0.4	0	-0.6	uAdc
Grid Emission Ic	Ef= 7.5 V; Ec= -7.0 Vdc Rg = 1.0 Meg	0	-0.4	---	---	uAdc
Heater-Cathode Leakage Ihk	Ehk= +100 Vdc	---	5	---	10	uAdc
Ihk	Ehk= -100 Vdc	---	-5	---	-10	uAdc
Insulation of Electrodes R(g-all)	Eg-all= -100 Vdc	100	---	50	---	Meg
R(p-all)	Ep-all= -300 Vdc	100	---	50	---	Meg

3.37.12 Table 3-60 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

TABLE 3-60. APPLICATION PRECAUTIONS FOR JAN-5718

Voltage

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
High, 3.1.8
Low, 3.1.15
AC Operation, 1.3.20, 3.1.10
28 Volt, 3.1.15
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.1.3
Cathode, 2.1.3, 3.1.12
Fixed, 1.3.8, 2.1.3, 3.1.2
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.37.13 In addition to the general considerations referenced in the preceding table, the JAN-5718, as specified by MIL-E-1/172B has initial assurance of radio frequency operation by an acceptance test of oscillation at 500 mc.

3.37.14 VARIABILITY OF CHARACTERISTICS.

3.37.15 The following charts define the extent of variation which may be exhibited among individual tubes. The boundaries of this variability were determined from the acceptance limits given on the specification.

3.37.16 Figure 3-218 presents the limit behavior of static plate characteristics for JAN-5718 as defined by MIL-E-1/172B dated 5 August 1955.

3.37.17 Figure 3-219 presents the limit behavior of plate transfer data for JAN-5718 as defined by MIL-E-1/172B dated 5 August 1955.

3.37.18 DESIGN CENTER CHARACTERISTICS.

3.37.19 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.37.20 Figure 3-220 presents the static plate characteristics of JAN-5718.

3.37.21 Figure 3-221 presents the typical plate transfer data for JAN-5718.

3.37.22 Figure 3-222 presents the typical Sm, Mu and rp characteristics of JAN-5718.

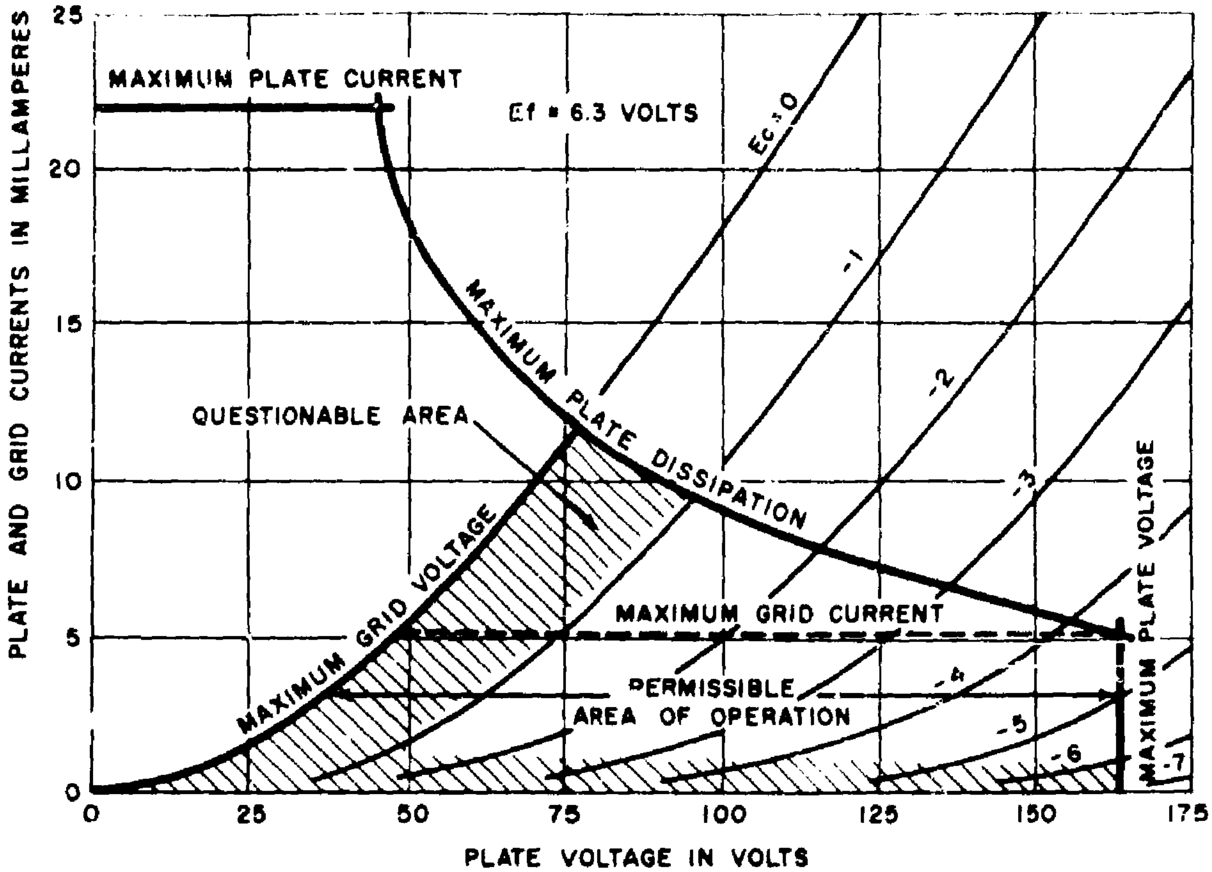


Figure 3-217. Typical Static Plate Characteristics of Tube Type JAN-5718; Permissible Area of Operation

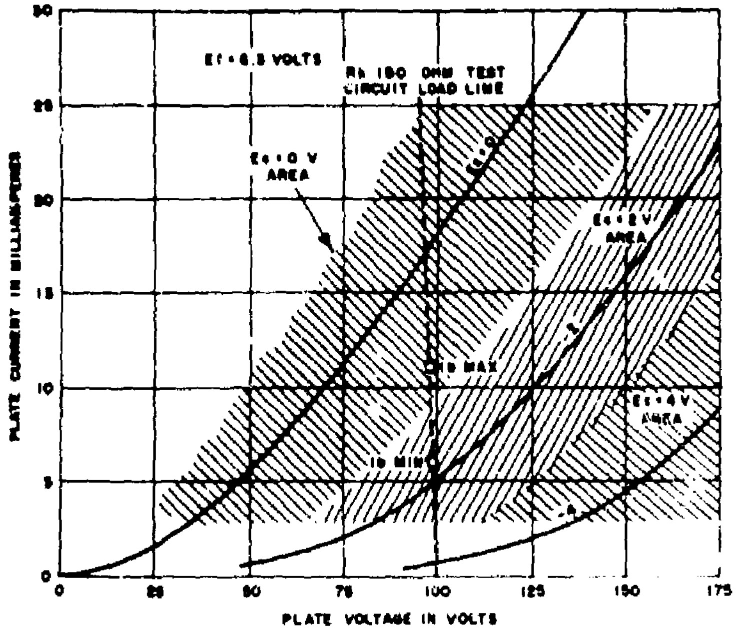


Figure 3-218. Limit Behavior of Tube Type JAN-5718, Static Plate Data; Variability of Ib

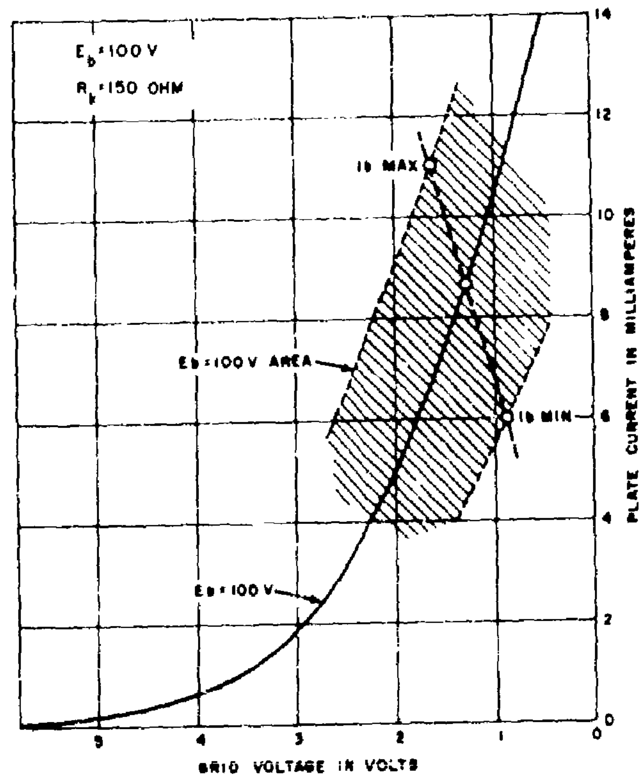


Figure 3-219. Limit Behavior of Tube Type JAN-5718 Transfer Data

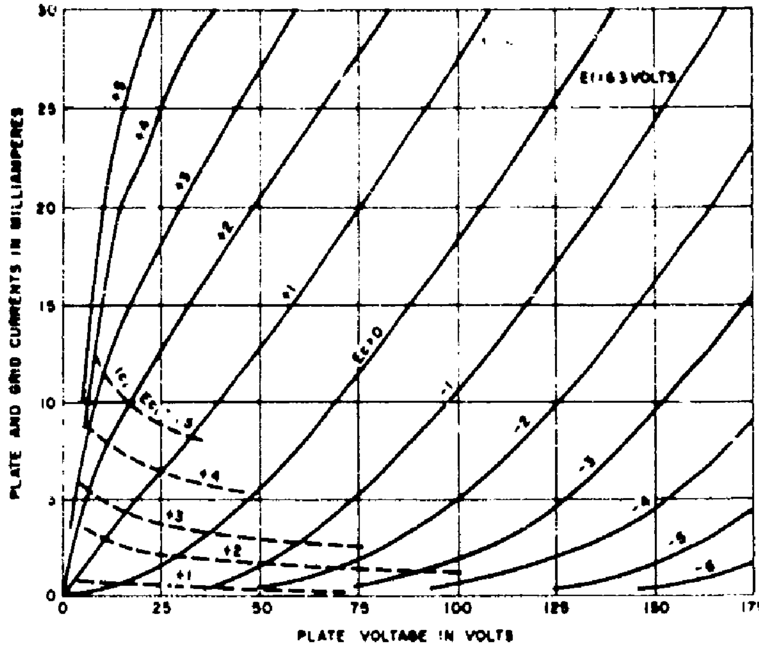


Figure 3-220. Typical Static Plate Characteristics of Tube Type JAN-5718

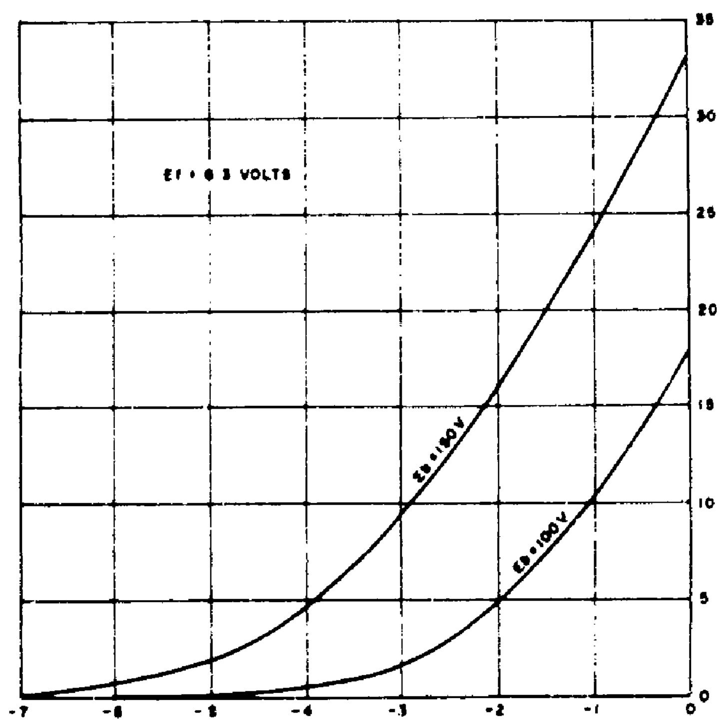


Figure 3-221. Typical Transfer Characteristics for Tube Type JAN-5718

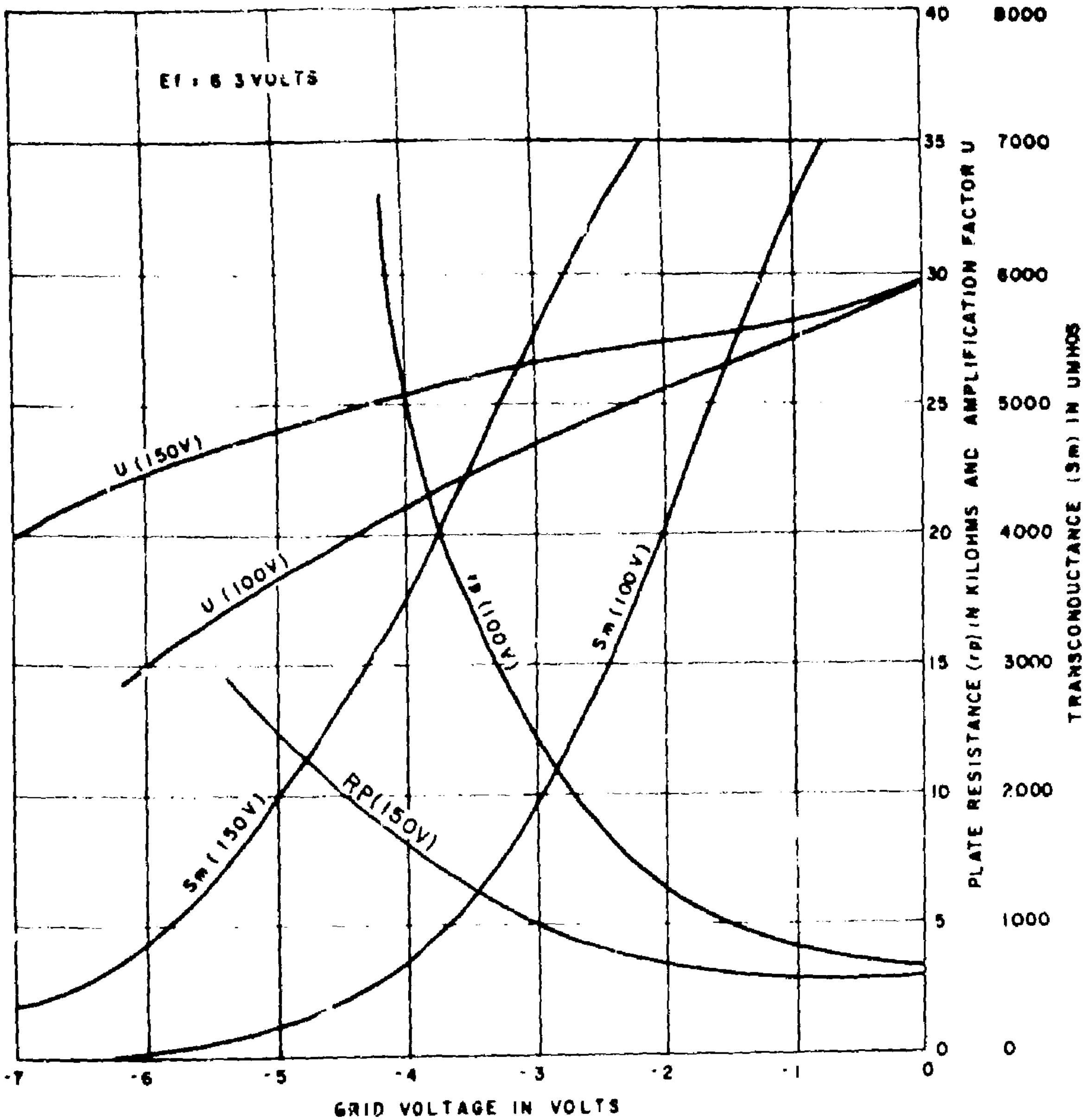


Figure 3-222. **Typical** Sm, Mu, and rp Characteristics for Tube Type JAN-5718

SECTION 38

TUBE TYPE JAN-5719

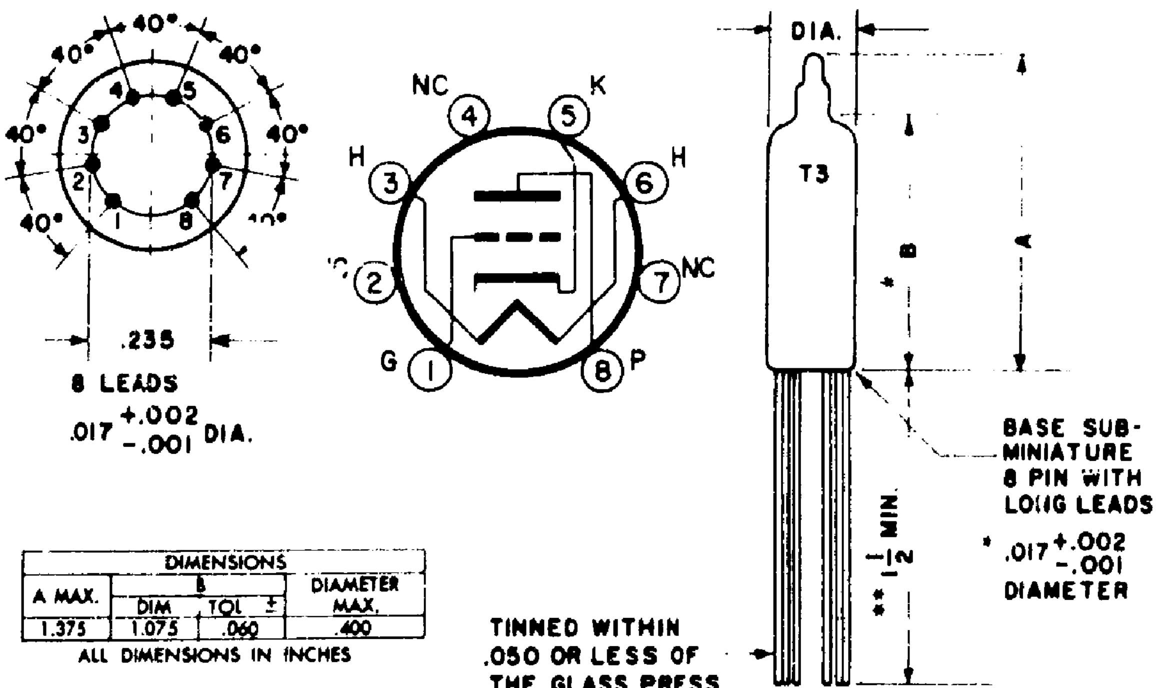
3.38 DESCRIPTION.

3.38.1 The JAN-5719 [1] is an 8-lead, button-base subminiature triode having a design center Mu of 70. The JAN-5719 is similar in plate characteristics to JAN-5751 and JAN-6112. The JAN-5719 has given satisfactory service in voltage-amplifier and other low-current triode applications.

3.38.2 **ELECTRICAL.** The electrical characteristics are as follows:

Heater Voltage .... 6.3 V
Heater Current, Design Center .... 150 mA
Cathode .... Coated Unipotential

3.38.3 **MOUNTING.** Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX.
	DIM	TOL ±	
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-223. Outline Drawing and Base Diagram of Tube Type JAN-5719

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[1] The values and specification comments presented in this section are related to MIL-E-1/173C dated 5 August 1955.

3.38.4 **RATINGS, ABSOLUTE SYSTEM.**

3.38.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 0.3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Control Grid Voltage, Maximum	0 Vdc
Control Grid Voltage, Minimum	-55 Vdc
Grid Series Resistance	1.2 Meg
Heater-Cathode Voltage	200 v
*Plate Current	3.3 mAdc
Plate Dissipation	0.10 W
Bulb Temperature	+220° C
Altitude Rating	60,000 ft

3.38.6 **TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.**

3.38.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Heater-Cathode Voltage	0 v
Cathode Resistance, Rk	1500 ohms
Heater Current, If	150 mA
Transconductance, Sm	1700 umhos
Amplification Factor, Mu	70

3.38.8 **ACCEPTANCE TEST LIMITS.**

3.38.9 Table 3-61 summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/173C dated 5 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.38.10 **APPLICATION.**

3.38.11 Figure 3-224 shows the permissible operating area for JAN-5719 as defined by the ratings in MIL-E-1/173C dated 5 August 1955. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

3.38.12 Table 3-62 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

* No test at this rating exists in the specification.

TABLE 3-61. ACCEPTANCE TEST LIMITS OF JAN-5719

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		140	160	138	164	mA
Transconductance (1)	Sm		1400	2000	---	---	umhos
Change in individuals	$\Delta \frac{Sm}{t}$		---	---	---	20	%
Transconductance (2)	Sm		---	10	---	15	%
	Ef		60	80	--	---	---
Amplification Factor	Mu						
Plate Current (1)	Ib		0.50	0.90	---	---	mAdc
Plate Current (2)	Ib	Ec= -2.5 Vdc	---	50	---	---	uAdc
Plate Current (3)	Ib	Ec= -1.8 Vdc	5	---	---	---	uAdc
Capacitance	Cgp	Ef = 0	0.6	1.0	---	---	uuf
(No Shield)	Cin	Ef = 0	1.2	2.2	---	---	uuf
	Cout	Ef = 0	0.4	0.8	---	---	uuf
Grid Current	Ic	Eb= 150 Vdc Rk= 2700 Rg= 1.0 Meg	0	-0.3	0	-.6	uAdc
Heater-Cathode Leakage							
	Ihk	Ehk= +100 Vdc	---	5.0	---	10.0	uAdc
	Ihk	Ehk= -100 Vdc	---	-5.0	---	-10.0	uAdc
Insulation of Electrodes							
R(g-all)		Eg-all= -100 Vdc	100	---	25	---	Meg
R(p-all)		Ep-all= -300 Vdc	100	---	25	---	Meg

3.38.13 OTHER CONSIDERATIONS.

3.38.14 In addition to the general considerations referenced in the following table, the JAN-5719 as specified by MIL-E-1/173C has initial assurance of AC amplification and plate current cutoff as follows:

3.38.15 PLATE CURRENT CUTOFF. Plate current cutoff is defined by two tests, one imposing a maximum Ib of 50 uAdc with 2.5 volt bias and a minimum Ib of 5 uAdc with 1.8 volt bias.

3.38.16 A-C AMPLIFICATION. A-C amplification using grid leak bias, 100 volt plate supply, and 0.5 megohm plate load resistance. Any operation in this region.

TABLE 3-62. APPLICATION PRECAUTIONS FOR JAN-5719

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
High, 3.1.8
Low, 3.1.15
AC Operation, 1.3.20, 3.1.10
28 Volt, 3.1.15
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.1.3
Cathode, 2.1.3, 3.1.12
Fixed, 1.3.8, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

other than that described, must be questioned considering the variable effects that are manifested in the low-current and zero-bias regions.

3.38.17 VARIABILITY OF CHARACTERISTICS.

3.38.18 The following charts show the variation which may be expected among individual tubes. The boundaries of this variability were determined from the acceptance limits given on the specification.

3.38.19 Figure 3-225 presents the limit behavior of static plate characteristics for JAN-5719 as defined by MIL-E-1/173C dated 5 August 1955.

3.38.20 Figure 3-226 presents the limit behavior of plate transfer data for JAN-5719 as defined by MIL-E-1/173C dated 5 August 1955.

3.38.21 DESIGN CENTER CHARACTERISTICS.

3.38.22 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.38.23 Figure 3-226 presents the static plate characteristics of JAN-5719.

3.38.24 Figure 3-227 presents the typical Sm, Mu, and rp Characteristics for JAN-5719.

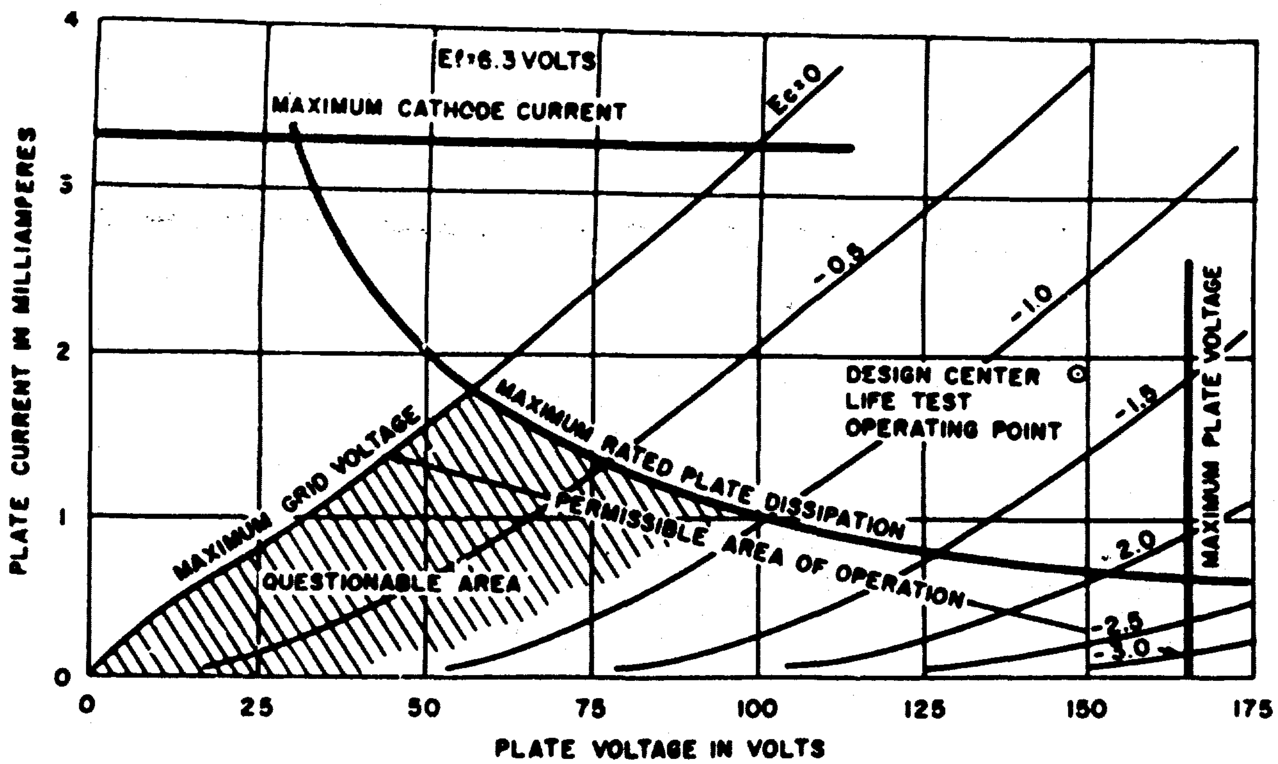


Figure 3-224. Permissible Area of Operation for Tube Type JAN-5719

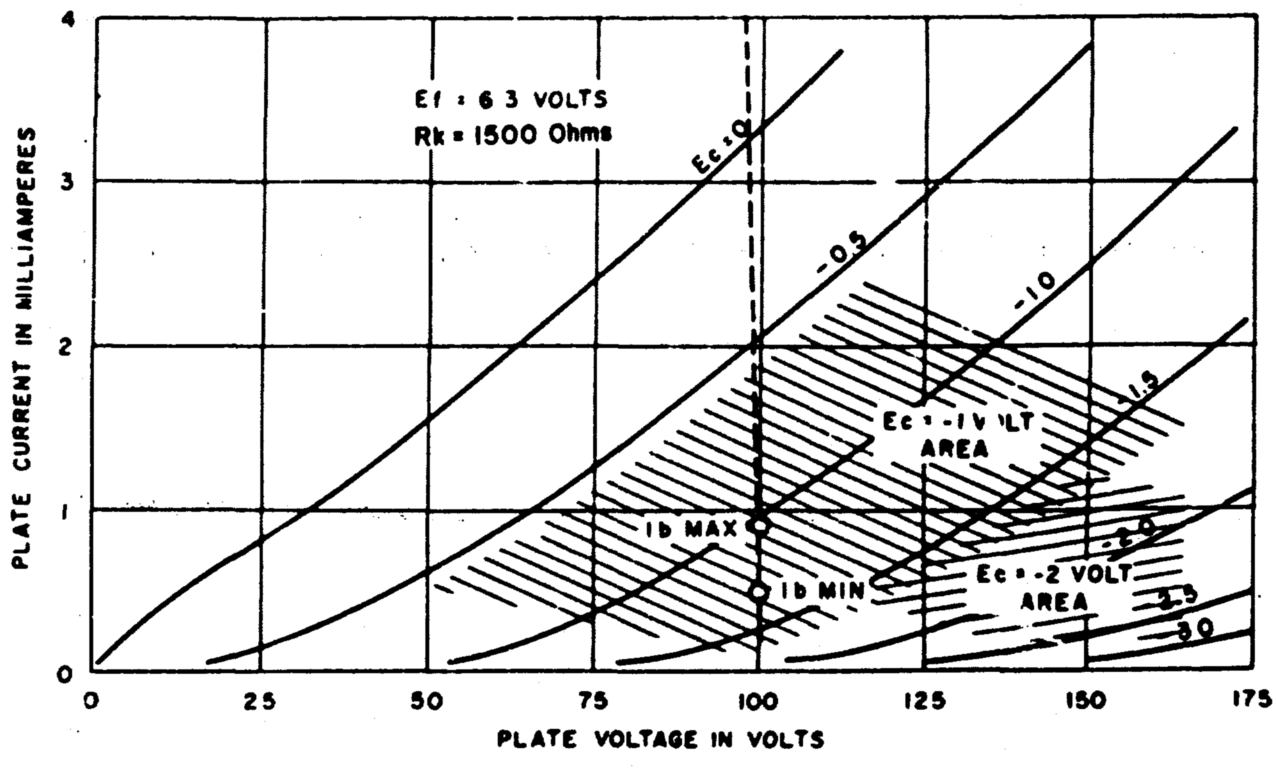


Figure 3-225. Variability of Static Plate Characteristics of Tube Type JAN-5719

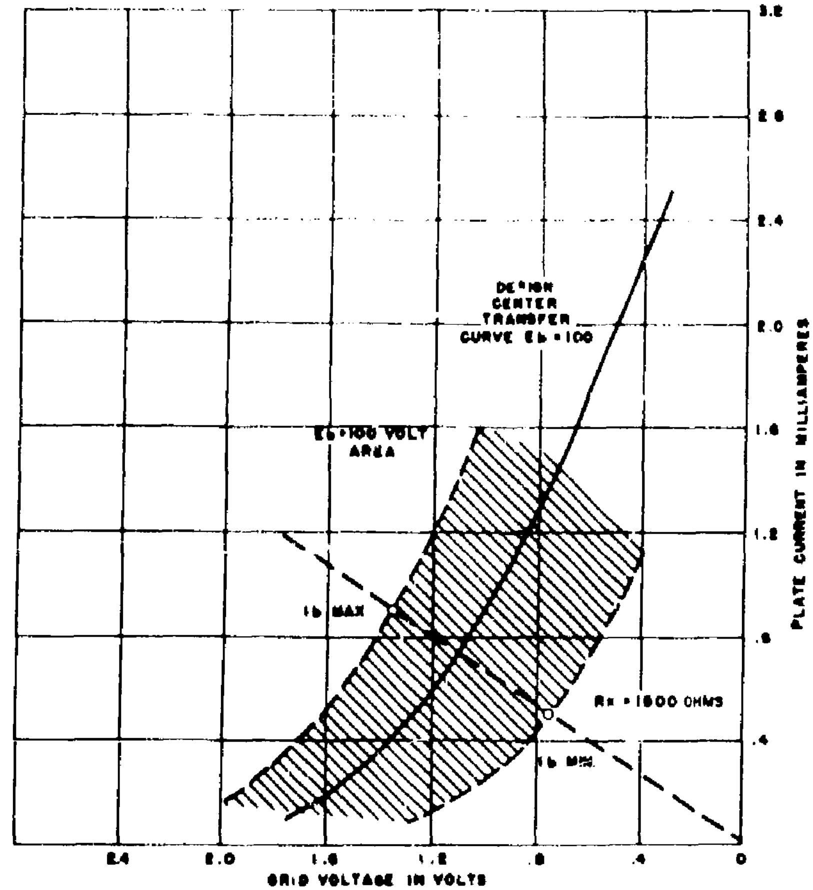


Figure 3-226. Limit Behavior of Tube Type JAN-5719 Transfer Data; Variability of Ib

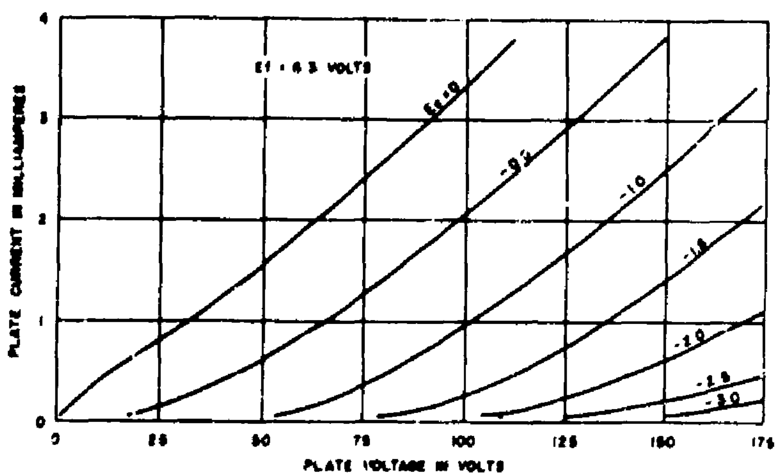


Figure 3-227. Typical Static Plate Characteristics for Tube Type JAN-5719

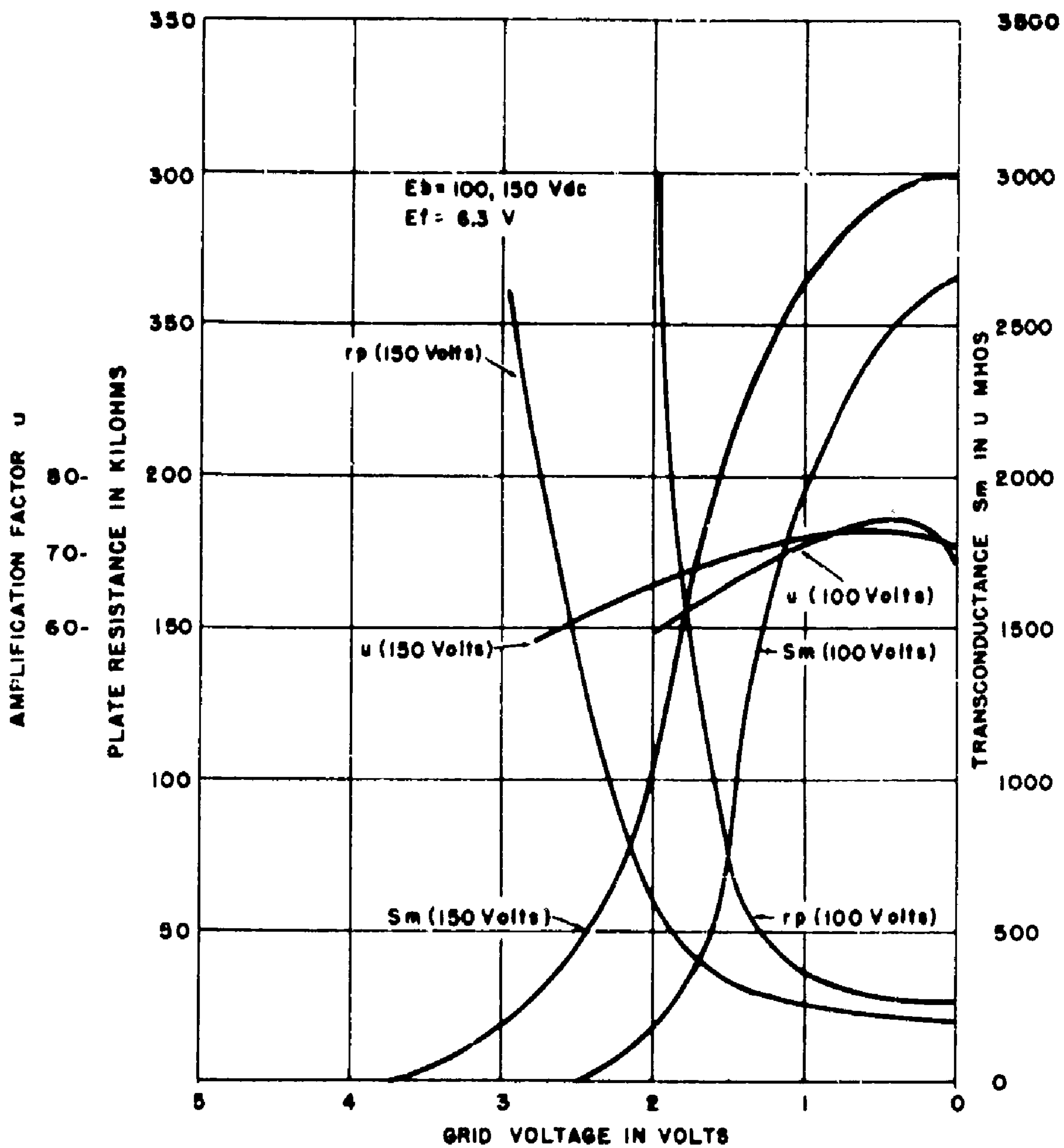


Figure 3-228. Typical Sm, u, rp Static Characteristics of Tube Type JAN-5719

SECTION 39

TUBE TYPE JAN-5725/6AS6W

3.39 DESCRIPTION.

3.39.1 The JAN-5725/6AS6W 1/ is a 7 pin miniature, sharp cutoff, dual control having a transconductance in the range, 2500 to 4500 micromhos.

3.39.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage, AC or DC . . . . 6.3 V
Heater Current, Design Center. . . . . 175 mA
Cathode . . . . Coated Unipotential

3.39.3 MOUNTING. Not specified.

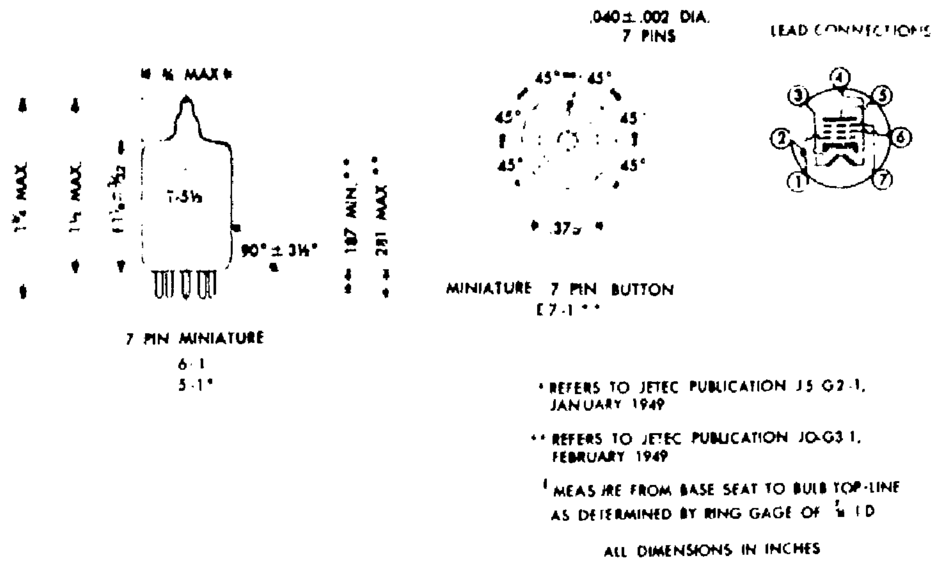


Figure 3-229. Outline Drawing and Base Diagram of Tube Type JAN-5725/6AS6W

3.39.4 RATINGS, ABSOLUTE SYSTEM.

3.39.5 The absolute system ratings are as follows:

Heater Voltage . . . . 6.3V ± .6V
Plate Voltage . . . . 200 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Control Grid Voltage Maximum Ec1 . . . . 0 Vdc
Minimum, Ec1 . . . . -55 Vdc
Screen Grid Voltage, Ec2 . . . . 155 Vdc
Heater Cathode Voltage, Ehk . . . . 100 V
Control Grid Series Resistance, Rg1 . . . . 0.1 meg

1/ The values and specification comments presented in this section are related to MIL-E-6B dated 5 December 1955.

* Cathode, Current, Ik	20 mAdc
Plate Dissipation, Pp	165 W
Control Grid Current, Ic1	1.0 mAdc
Screen Grid Dissipation, Pg2	0.55 W
Suppressor Grid Current, Ic3	0.2 mAdc
Bulb Temperature, T envelope	165°C
* Altitude	60,000 ft

3.39.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.39.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	120 Vdc
Control Grid Voltage, Ec1	2.0 Vdc
Screen Grid Voltage, Ec2	120 Vdc
Suppressor Voltage	0 Vdc
Heater Cathode Voltage	0 V
Heater Current, If	175 mA
Plate Current, Ib	5.2 mAdc
Transconductance, Sm(control grid plate)	3200 umhos

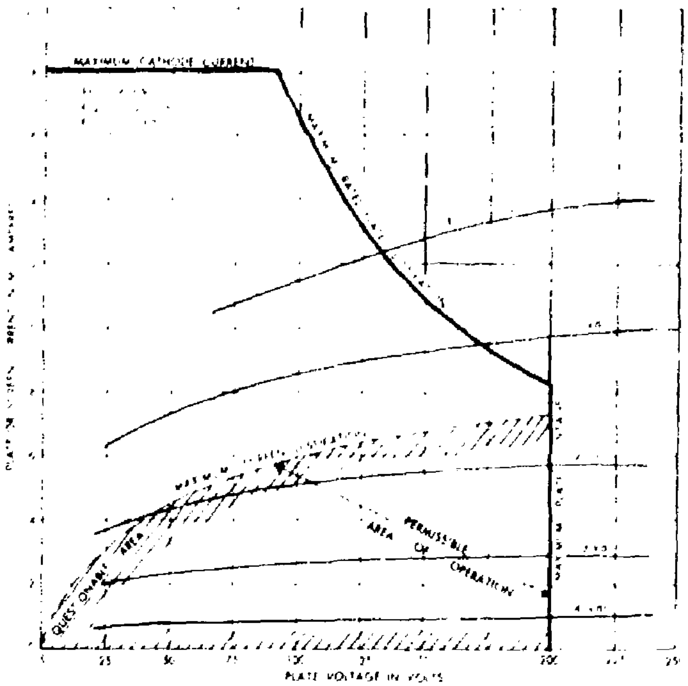


Figure 3-230. Typical Plate Characteristics of JAN-5725/6AS6W; Permissible Area of Operation

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

3.39.8 ACCEPTANCE TEST LIMITS.

3.39.9 Table 3-63 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/6B dated 5 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.39.10 APPLICATION.

3.39.11 Figure 3-230 shows the permissible operating area for JAN-5725/6AS6W as defined by the ratings in MIL-E-1/6B dated 5 December 1955. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

3.39.12 Table 3-64 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-63. ACCEPTANCE TEST LIMITS OF JAN-5725/6AS6W

PROPERTY	MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	INITIAL MAX	LIFE TEST MIN	LIFE TEST MAX	UNITS
Heater Current If		160	190	160	190	mA
Transconductance (1) Sm		2500	4500	---	---	umhos
Change in individual Δ Sm t		---	---	---	20	%
Transconductance (2) Δ Sm Ef		---	15	---	15	%
Transconductance (3) S(g3-p)	Ec3 = -3 Vdc	400	1150	---	---	umhos
Transconductance (4) S(gl-p)	Ec3 = -5 Vdc	700	1700	---	---	umhos
Plate Current (1) Ib		2.5	9.0	---	---	mAdc
Plate Current (2) Ib	Ecl = -3 Vdc Ec3 = -10 Vdc	---	200	---	---	uAdc
Plate Current (3) Ib	Ecl = -3 Vdc Ec3 = -6 Vdc	5	---	---	---	uAdc
Plate Current (4) Ib	Ecl = -8 Vdc	---	200	---	---	uAdc
Plate Current (5) Ib	Ecl = -6 Vdc	5	---	---	---	uAdc
Screen Grid Current Ic2		1.5	5.5	---	---	mAdc
Capacitance Cgl-p	Ef = 0	---	0.02	---	---	uuf
(Shielded as Cin	Ef = 0	3.5	4.5	---	---	uuf
specified) Cout	Ef = 0	2.6	3.4	---	---	uuf
Grid Current IcI	Rgl = 0.1 Meg	0	-0.1	0	-0.1	uAdc
Grid Emission Iscl	Ef =7.5 V	0	-0.1	0	-0.1	uAdc
	Ecl = -10 Vdc	0	-1.0	---	---	uAdc
	Rgl = 0.1 Meg					
Heater-Cathode Ihk	Ehk = 100 Vdc	---	10	---	10	uAdc
Leakage Ihk	Ehk = -100 Vdc	---	-10	---	-10	uAdc
Electrode R(gl-all)	Egl-all = -100 Vdc	100	---	50	---	Meg
Insulation R(g3-all)	Eg3-all = -100 Vdc	100	---	50	---	Meg
R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

TABLE 3-64. APPLICATION PRECAUTIONS FOR JAN-5725/6AS6W

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.39.13 VARIABILITY OF CHARACTERISTICS.

3.39.14 The published technical data which describe and define electron tubes, in general, present only average or center values. Consequently the variation inherent in a typical characteristic curve is frequently overlooked. The following charts define the extent of variation which may be exhibited between individual tubes. The boundaries of this variability were determined from the acceptance limits given on the specification.

3.39.15 Figures 3-231, 3-232, 3-233, and 3-234 present the limit behavior of static plate and transfer characteristics for JAN-5725/6AS6W as defined by MIL-E-1/6B dated 5 December 1955.

3.39.16 DESIGN CENTER CHARACTERISTICS

3.39.17 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.39.18. Figures 3-235, 3-236, 3-237 and 3-238 present the Static Plate Characteristics of JAN-5725/6AS6W.

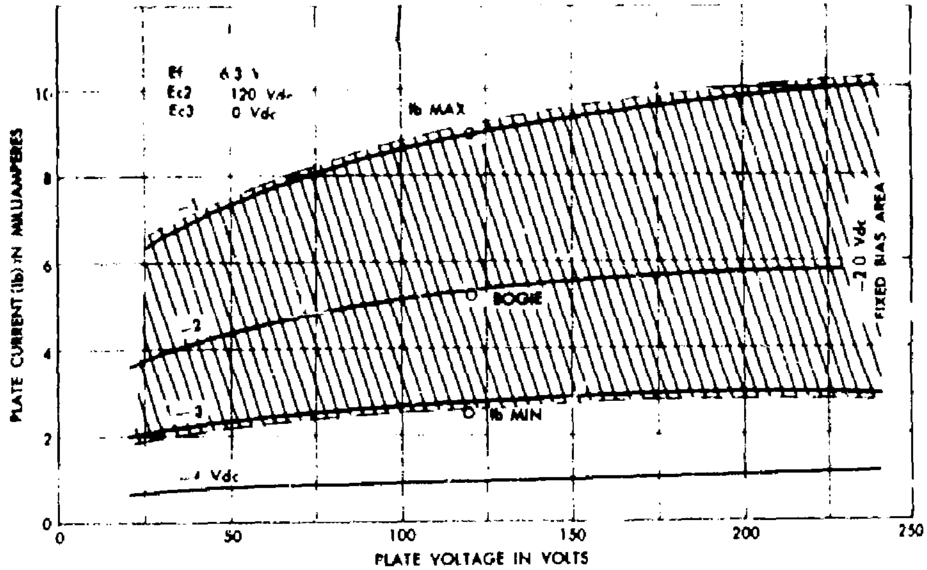


Figure 3-231. Plate Characteristic Variability of JAN-5725/6AS6W

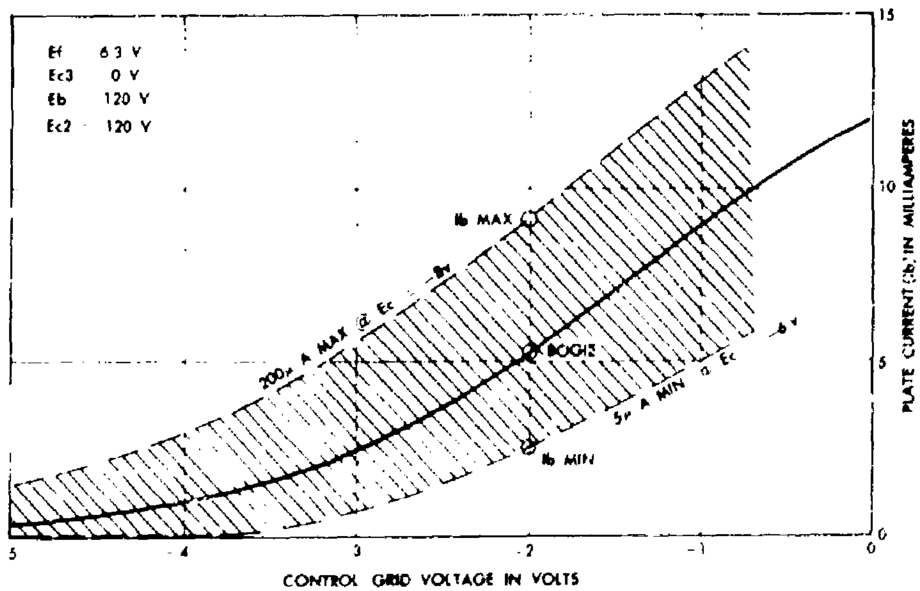


Figure 3-232. Transfer Characteristic Variability of JAN-5725/6AS6W

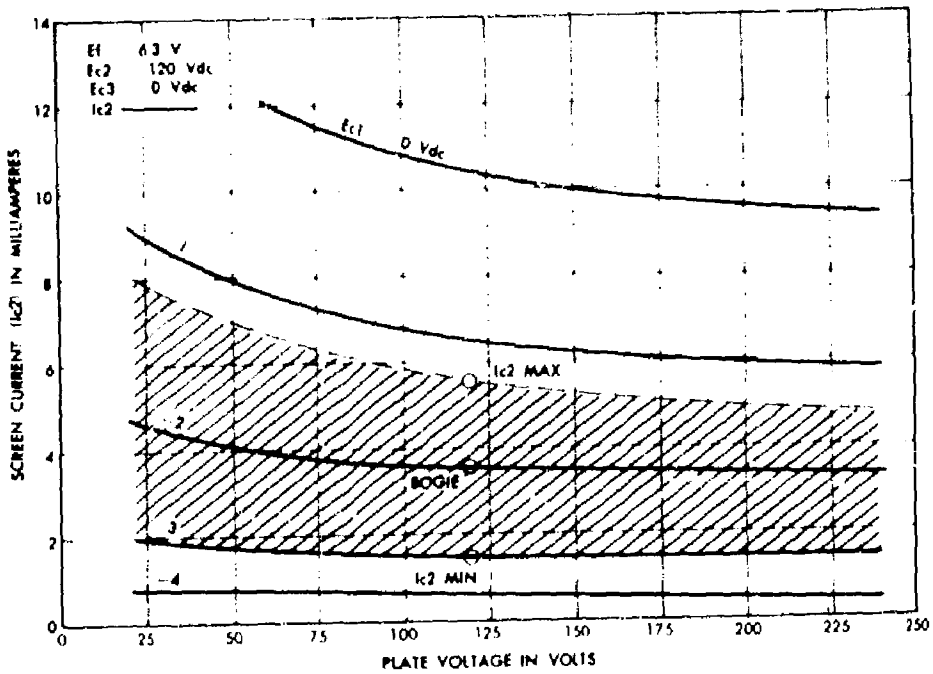


Figure 3-233. Ic2 Variability of JAN-5725/6AS6W

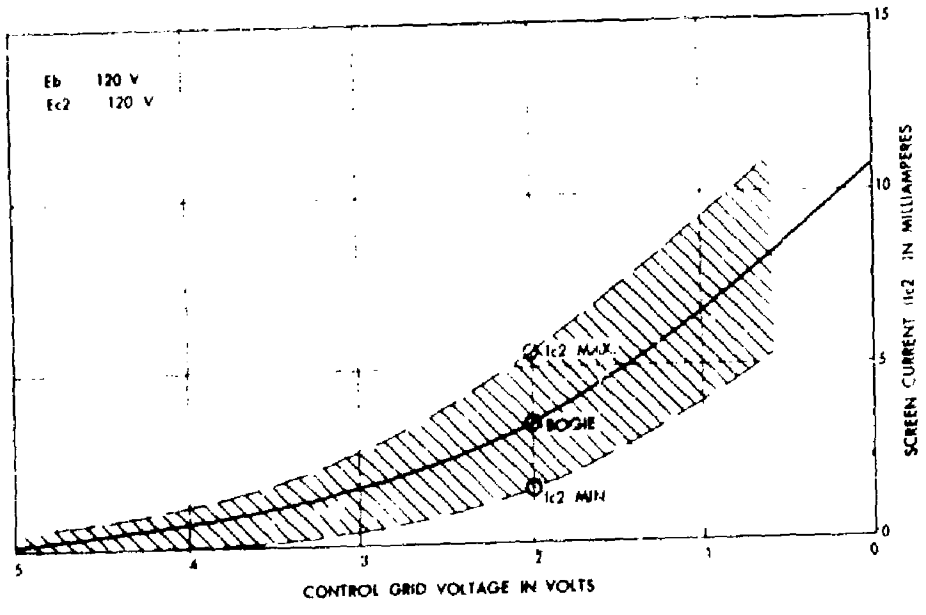
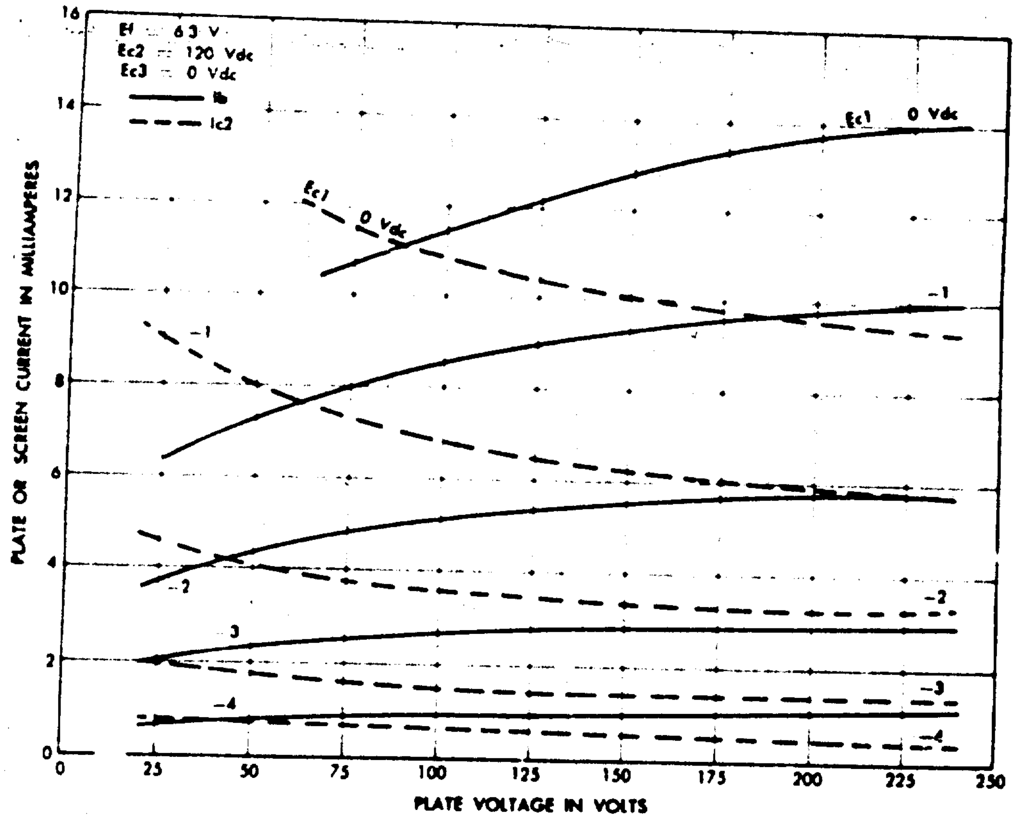


Figure 3-234. Screen Transfer Characteristic Variability of JAN-5725/6AS6W



igure 3-235. Typical Plate and Screen Characteristics of JAN-5725/6AS6W

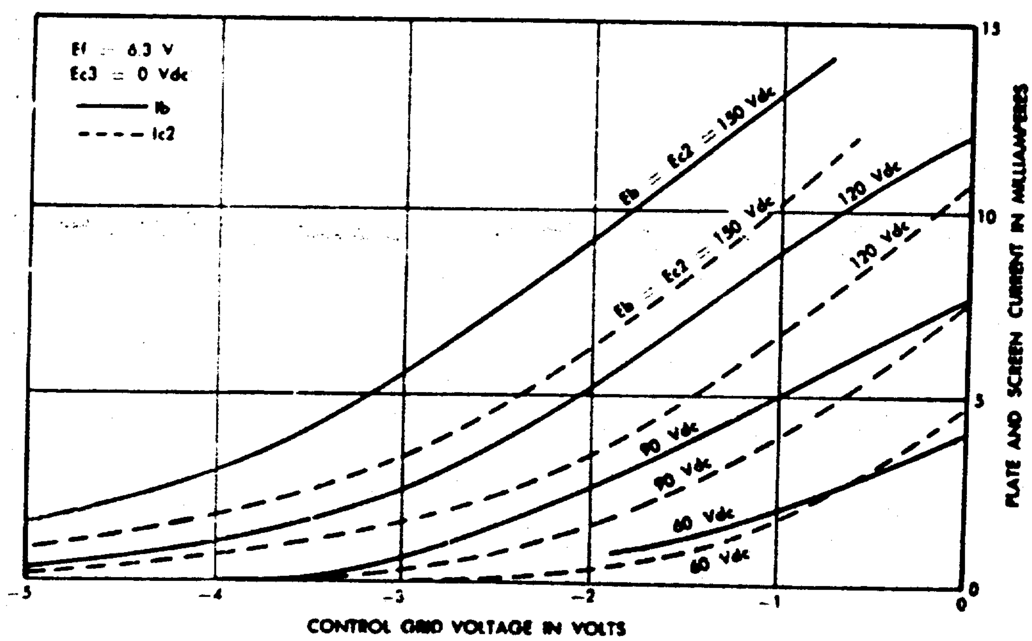


Figure 3-236. Typical Trar ⁴fer Characteristics of JAN-5725/6AS6W

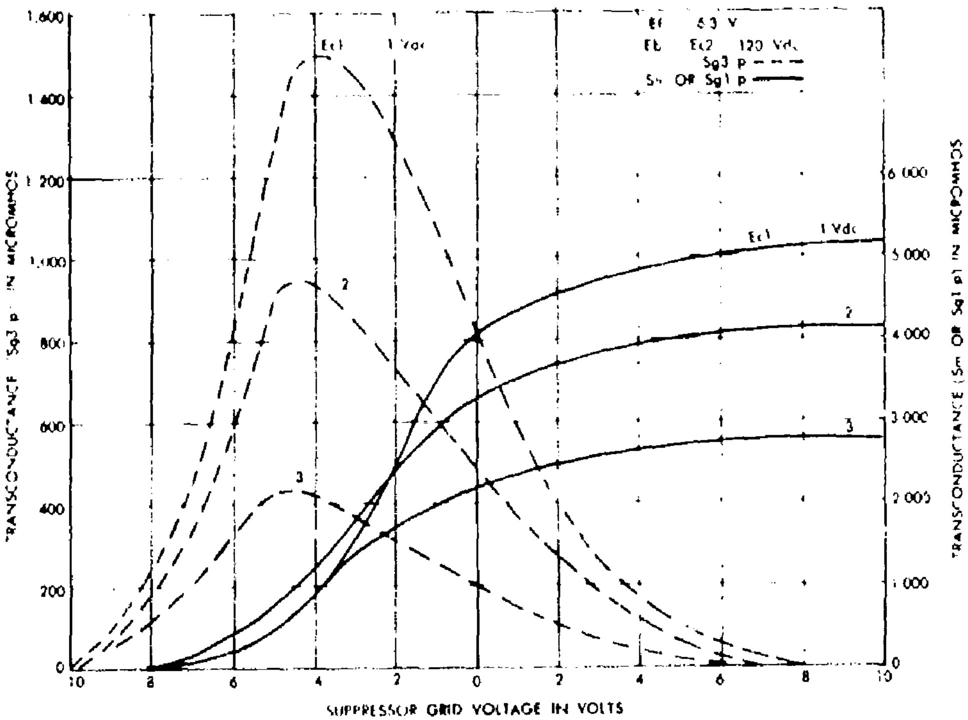


Figure 3-237. Typical Sm and Suppressor to Plate Transconductance Characteristics of JAN-5725/6AS6W; Parametric in Ec1

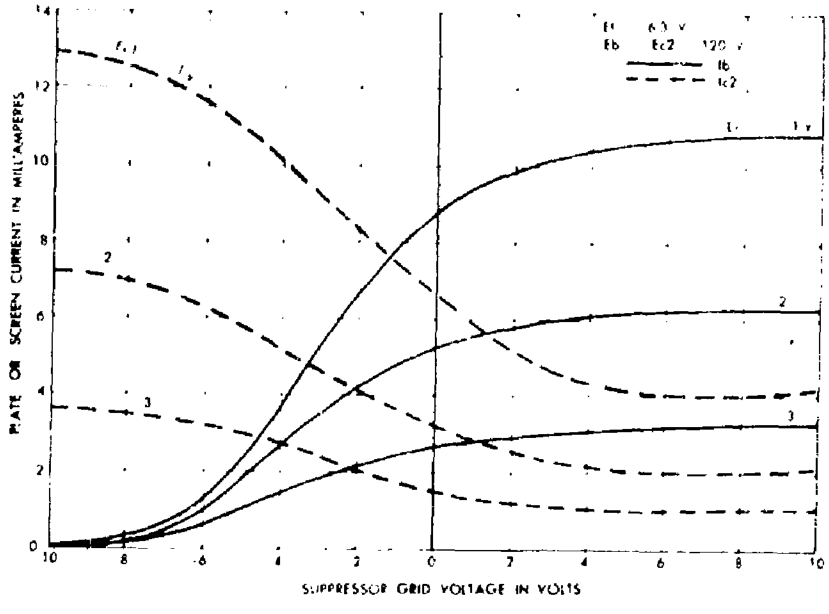


Figure 3-238. Typical Suppressor to Plate or Screen Transfer Characteristics of JAN-5725/6AS6W; Parametric in Ec1

SECTION 40

TUBE TYPE JAN-5726/6AL5W

3.40 DESCRIPTION.

3.40.1 The JAN-5726/6AL5W 1/ is a seven pin, button base, miniature, double diode.

3.40.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current . . . . 300 mA
* Cathode. . . . . Coated Unipotential

3.40.3 MOUNTING. Not specified.

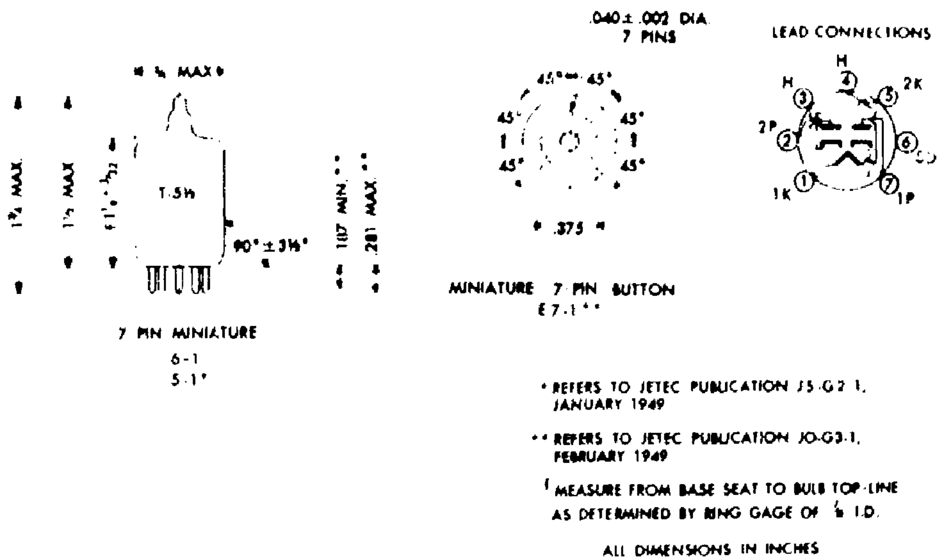


Figure 3-239. tline Drawing and Base Diagram of Tube Type JAN-5726/6AL5W

3.40.4 RATING, ABSOLUTE SYSTEM.

1/ The values and specification comments presented in this section are related to MIL-E-1/7A dated 3 May 1954.

* Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

3.40.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 0.6 V
Peak Inverse Plate Voltage	360 v
Steady State Peak Plate Current (per plate)	60 ma
Output Current (per plate)	10 mAdc
Transient Peak Plate Current	350 ma
Heater Cathode Voltage	± 360 V
** Bulb Temperature	140° C
** Altitude Rating	10,000 ft

3.40.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.40.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Supply Voltage (per plate), Epp	165 Vac
Load Resistance (RL)	11,000 ohms
Load Capacitor (CL)	8 uf
Heater Current	300 mA
Output Current (both plates), Io	18 mA

3.40.8 ACCEPTANCE TEST LIMITS.

3.40.9 Table 3-65 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/7A dated 3 May 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.40.10 APPLICATION.

3.40.11 SIGNAL RECTIFIER SERVICE: In the application of JAN-5726/6AL5W in signal rectifier service, Fig. 3-240 relates boundaries of permissible operation and the questionable area of operation, to the plate characteristic.

** No test at this rating exists in the specification.

TABLE 3-65. ACCEPTANCE TEST LIMITS OF JAN-5726/6AL5W

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		275	325	275	325	mA
Operation	Io	See Note Below	16	---	14	---	mAdc
Plate Current	Ib	Ebb = 0; Rp = 40,000 ohms	2.0	20	---	---	uAdc
Difference between sections	Δ Ib		---	5	---	---	uAdc
Emission	Is	Eb = 10 Vdc	40	---	---	---	mAdc
Capacitance (Shielded as specified) C1p to 2p		Ef = 0	---	0.026	---	---	uuf
C1p to h+1k+sd		Ef = 0	2.4	4.0	---	---	uuf
C2p to h+2k+sd		Ef = 0	2.4	4.0	---	---	uuf
C1k to h+1p+sd		Ef = 0	3.1	4.7	---	---	uuf
C2k to h+2p+sd		Ef = 0	3.1	4.7	---	---	uuf
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	---	10	---	20	uAdc
	Ihk	Ehk = -100 Vdc	---	-10	---	-20	uAdc
Insulation of Electrodes	R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

Note: In a full wave circuit adjust Zp (per plate) so that a bogie tube gives Io = 18 mAdc, and ib = 50 mAdc per plate. A bogie tube has a tube drop E_{td} = 10 Vdc at I_s = 60 mAdc per plate.

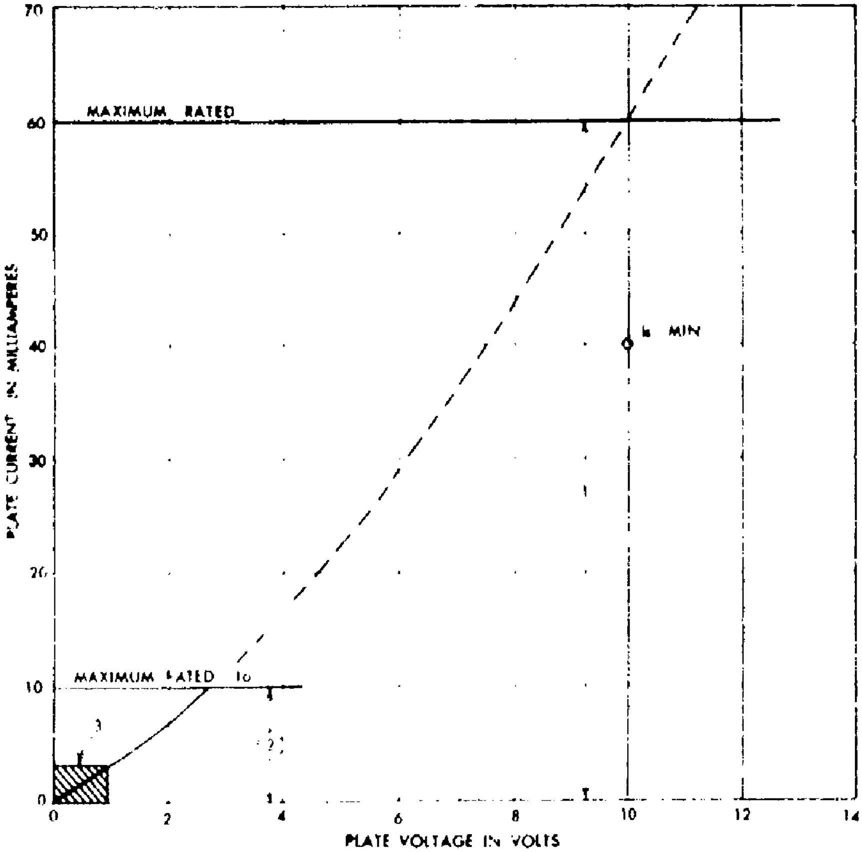


Figure 3-240. Typical Plate Characteristic of JAN-5726/6AL5W; Permissible Area of Operation

3.40.12 Permissible steady state peak plate current is limited to 60 milliamperes per plate, to define boundary (1), and dc output current is limited to 10 milliamperes per plate to define boundary (2). Area (3) is defined as questionable from the standpoint of uniformity and stability of plate current in low-level signal rectifier applications. Although the specification enforces a control on plate current balance between the two sections to within 5 microamperes under MIL-E-1 test conditions, there is little assurance of such balance under conditions of heater operation differing from test conditions. Reference should be made to Section 1.3.4 for a review of the behavior of initial electron velocity and contact potential in tubes in general, where the control grid currents discussed are equivalent to plate currents in signal diode application.

3.40.13 SUPPLY VOLTAGE RECTIFIER SERVICE: Rating Charts I, II, and III, (Figures 3-241, 3-242, 3-243) represent areas of permissible operation within which any application of the JAN-5726/6AL5W must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

Note: Boundary curve is based on maximum rated steady state plate current of 60 mA per plate. For Capacitor - Input Filter (Rs = 500 ohms per plate)

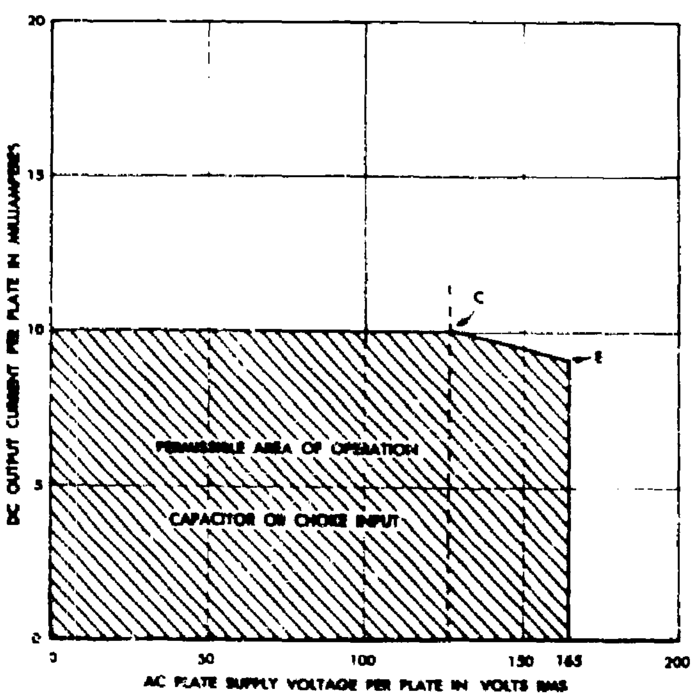


Figure 3-241. Rating Chart I for Tube Type JAN-5726/6AL5W

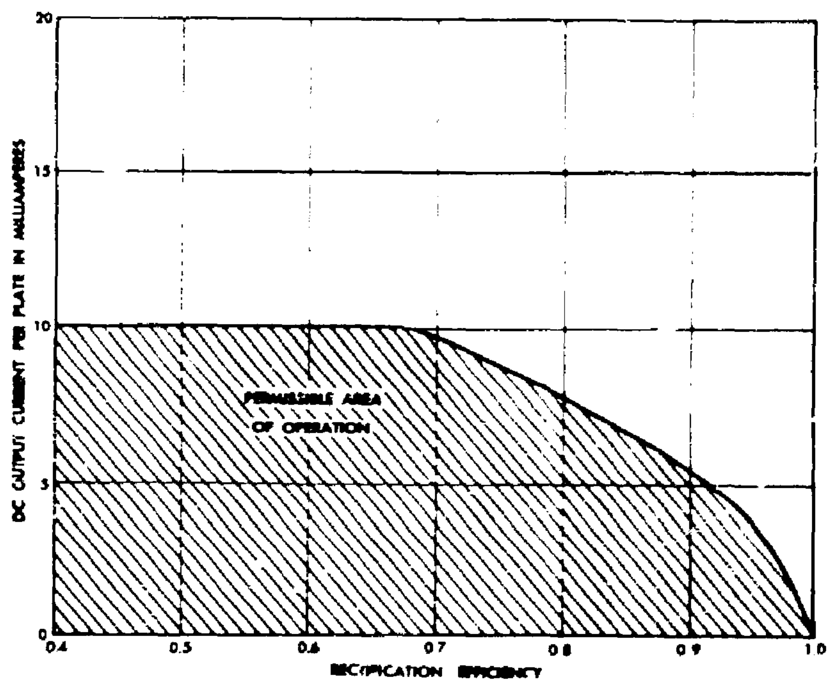
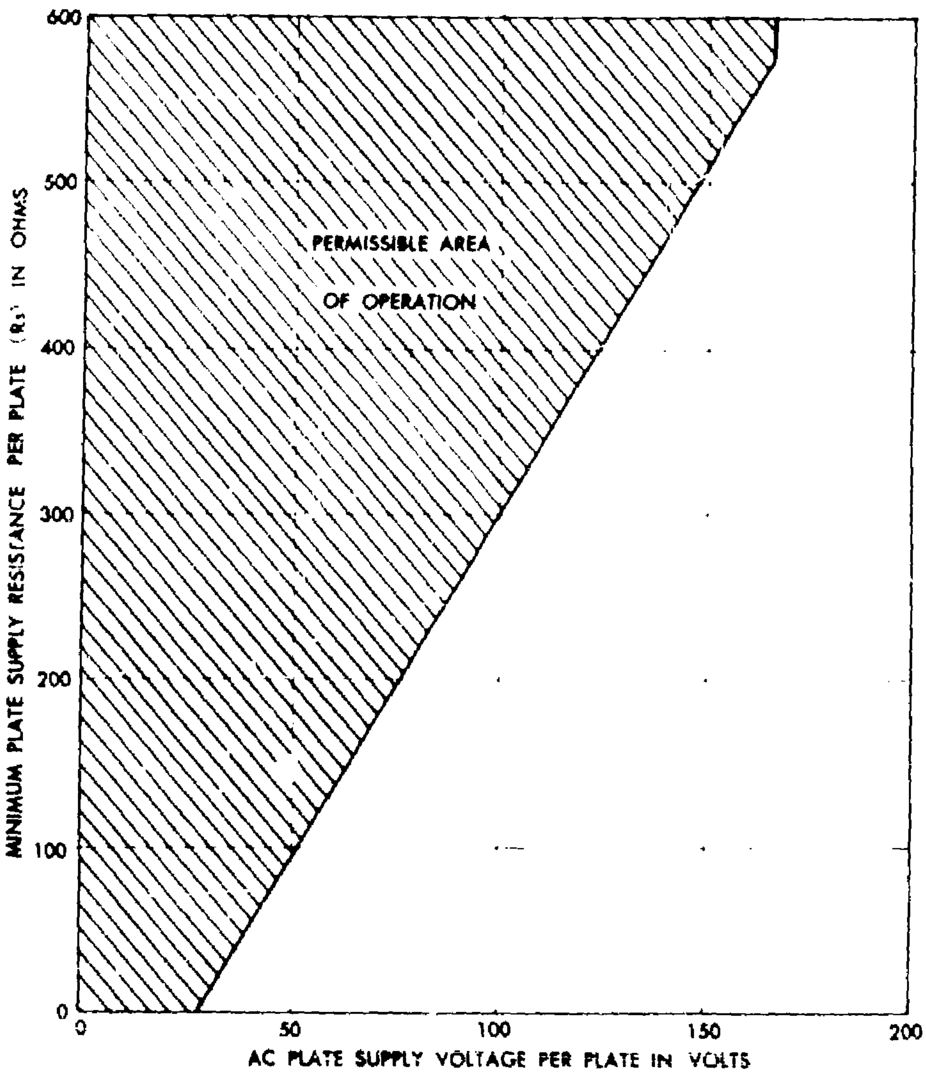


Figure 3-242. Rating Chart II for Tube Type JAN-5726/6AL5W

3.40.14 RATING CHART I (figure 3-241) is based on maximum rated peak inverse voltage per plate (epx) of 360 volts and maximum rated dc output current per plate (Io) of 10 milliamperes. Point C corresponds to the occurrence of these two ratings, permissible under choke or capacitor-input filter conditions. Point E is based on life test conditions, with capacitor input filter.

3.40.15 RATING CHART II (figure 3-242) for capacitor input filter applications is based on maximum rated dc output current per plate (Io) and maximum rated steady peak plate current (ib) of 60 milliamperes per plate. Rectification efficiency must not exceed 0.67 under conditions of maximum rated dc output current.



F

Figure 3-243. Rating Chart III for Tube Type JAN-5726/6AL5W

3.40.16 RATING CHART III (figure 3-243) for capacitor input filter is based on maximum rated surge current (i surge) of 350 milliamperes per plate. Minimum permissible series resistance (Rs) is approximately 580 ohms per plate under conditions of maximum permissible supply voltage per plate.

3.40.17 OTHER CONSIDERATIONS.

3.40.18 HEATER VOLTAGE: See paragraph 3.4.8.

3.40.19 LOW ELECTRODE CURRENT: See paragraph 3.4.7.

3.40.20 AVERAGE CHARACTERISTICS.

3.40.21 Figures 3-244 and 3-245 present the Static Plate Characteristics of JAN-5726/6AL5W, reproduced from data published by the original RETMA registrant of this type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification which provides only a minimum limit on emission.

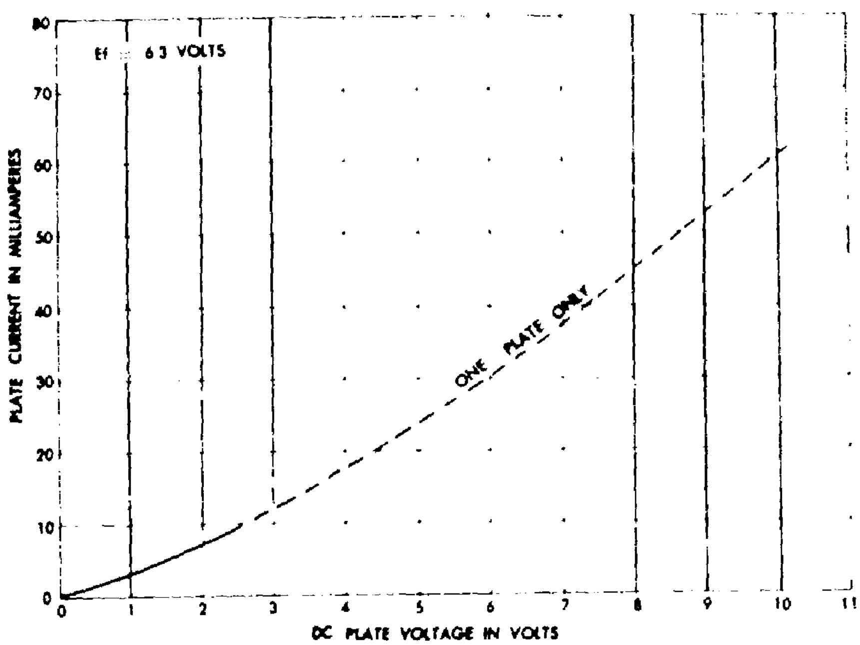


Figure 3-244. Typical Plate Characteristics of JAN-5726/6AL5W

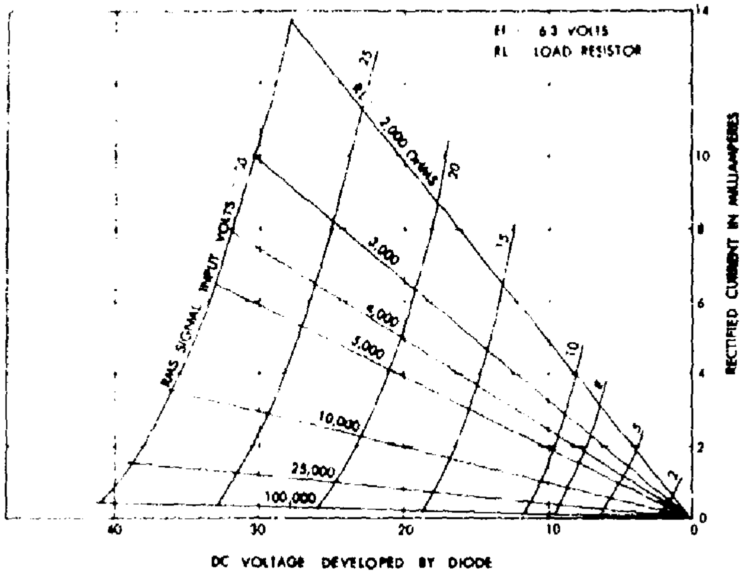


Figure 3-245. Typical Rectifier Characteristics of JAN-5726/6AL5W

SECTION 41

TUBE TYPE JAN-5744WA

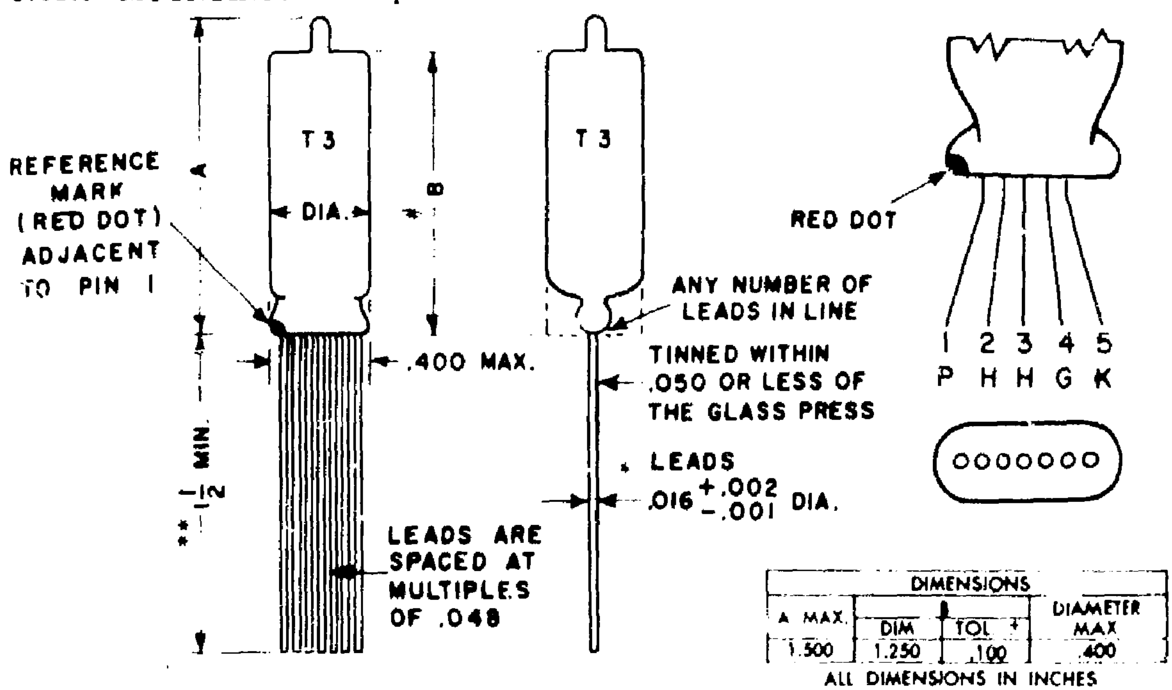
3.41 DESCRIPTION.

3.41.1 The JAN-5744WA[1] is a 5-lead, flat-press subminiature triode having a Mu in the range of 60 to 80. The JAN-5744WA has given satisfactory service in voltage-amplifier and other low-current applications.

3.41.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage .... 6.3 V
Heater Current, Design Center .... 200 mA
Cathode .... Coated Unipotential

3.41.3 MOUNTING. Not specified.



\# MEASURE FROM BASE SEAT TO BULB TOP-LI[illegible] AS DETERMINED BY RING GAGE OF .210 [illegible] .001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-246. Outline Drawing and Base Diagram of Tube Type JAN-5744WA

[1] The values and specification comments presented in this section are related to MIL-E-1 84B dated 16 July 1954.

3.41.4 RATINGS, ABSOLUTE SYSTEM.

3.41.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 0.6 V
Plate Voltage Reference MIL-E-1B Section 3.5.1.1 Plate Voltage	275 Vdc
Grid Voltage, Minimum	-55 Vdc
Heater-Cathode Voltage	200 v
**Plate Current, Maximum	6.5 mAdc
*Plate Current, Minimum	0.5 mAdc
*Plate Dissipation	1.6 W
*Bulb Temperature	+265° C
*Altitude Rating	60,000 ft

3.41.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.41.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	250 Vdc
Cathode Resistance, Rk	500 ohms
Heater-Cathode Voltage	0 Vdc
Heater Current, If	200 mA
Plate Current, Ib	4.2 mAdc
Transconductance, Sm	4000 umhos
Amplification Factor, Mu	70

3.41.8 ACCEPTANCE TEST LIMITS.

3.41.9 Table 3-66 summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/84B dated 16 July 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.41.10 APPLICATION.

3.41.11 Figure 3-247 shows the permissible operating area for JAN-5744WA as defined by the ratings in MIL-E-1/84B dated 16 July 1954. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

* No test of operation at this rating exists in the specification.

** No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-66. ACCEPTANCE TEST LIMITS OF JAN-5744WA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		183	217	183	217	mA
Transconductance (1)	Sm		3200	4800	---	---	umhos
Change in individuals	Δ Sm t		---	---	---	25	%
Amplification Factor	Mu		60	80	---	---	----
Plate Current (1)	Ib		2.8	5.7	---	---	mAdc
Capacitance	Cap	Ef = 0	0.65	0.95	---	---	uuf
(Shielded	Cin	Ef = 0	2.0	3.4	---	---	uuf
as specified)	Cout	Ef = 0	1.7	3.1	---	---	uuf
Grid Current (1)	Ic		0	-0.3	---	-0.6	uAdc
Grid Current (2)	Ic	Ef = 70V	0	-0.3	---	-1.0	uAdc
Heater-Cathode Leakage	Ihk	Ehk= +100 Vdc	---	10	---	30	uAdc
	Ihk	Ehk= -100 Vdc	---	-10	---	-30	uAdc
Insulation of Electrodes	R(g-all)	Eg-all= -100 Vdc	100	---	50	---	Meg
	R(p-all)	Ep-all= -300 Vdc	100	---	50	---	

3.41.12 Table 3-67 lists general considerations for the application of this type. The numbers refer to the applicable paragraphs of this Manual.

3.41.13 OTHER CONSIDERATIONS.

3.41.14 In addition to the considerations noted above, JAN-5744WA, as reflected in Specification MIL-E-1/84B, provides limited assurance of operation in the low plate-voltage, low plate-current region by an acceptance test for a-c amplification using grid-leak bias, 100-volt plate supply, and 0.5-megohm plate-load resistance. Any operation in this region, other than that described above, must be questioned considering the variable effects that are manifested in the low-current and zero-bias regions.

3.41.15 VARIABILITY OF CHARACTERISTICS.

3.41.16 The following charts show the amount of variation which must be expected among individual tubes. The variability boundaries of these were determined from the acceptance limits given on the specification.

TABLE 3-67. APPLICATION PRECAUTIONS OF JAN-5744WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27
1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
- High, 3.1.8
- Low, 3.1.15
- AC Operation, 1.3.20, 3.1.10
- 28 Volt, 3.1.15

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.1.3
- Cathode, 2.1.3, 3.1.12
- Fixed, 1.3.8, 2.1.3, 3.1.4

Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19,
1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35,
2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23,
3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability,
1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.41.17 Figure 3-248 presents the limit behavior of static plate characteristics for JAN-5744WA as defined by MIL-E-1/84B dated 16 July 1954.

3.41.18 Figure 3-249 presents the limit behavior of plate transfer data for JAN-5744WA as defined by MIL-E-1/84B dated 16 July 1954.

3.41.19 DESIGN CENTER CHARACTERISTICS.

3.41.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.41.21 Figure 3-250 presents the static plate characteristics of JAN-5744WA.

3.41.22 Figure 3-251 presents the average Sm, Mu and rp characteristics for JAN-5744WA.

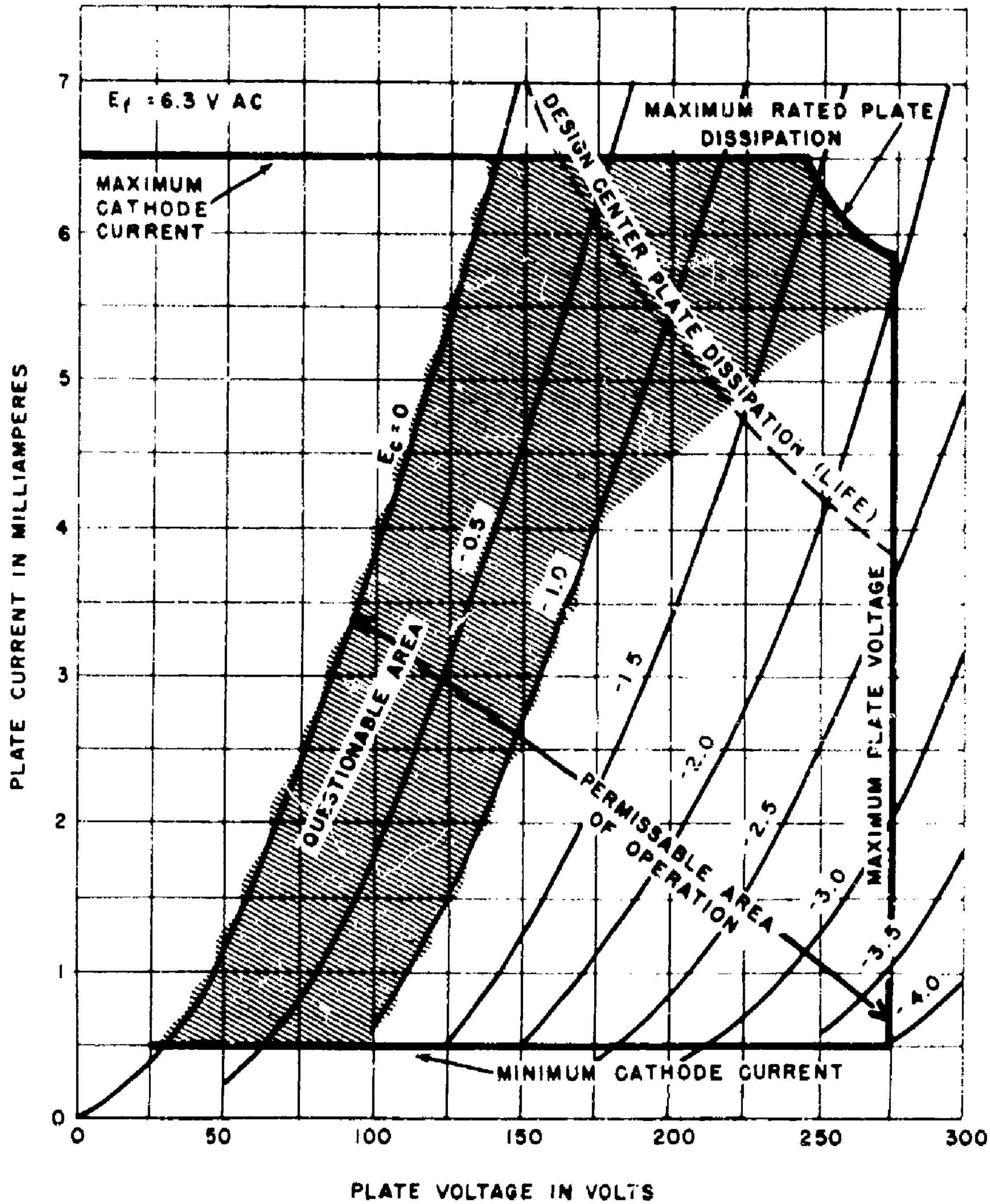


Figure 3-247. **Typical Static Plate Characteristics of Tube Type JAN-5744WA; Permissible Area of Operation**

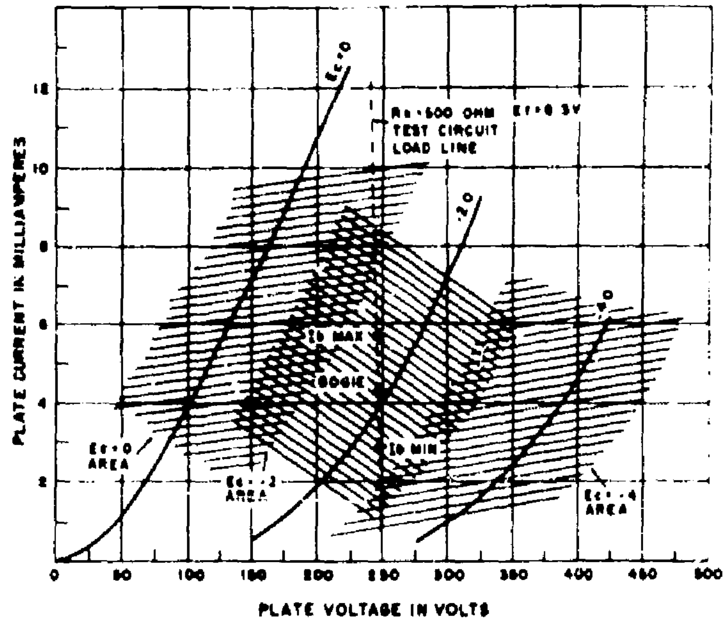


Figure 3-248. Limit Behavior of Tube Type JAN-5744WA Static Plate Data; Variability of Ib

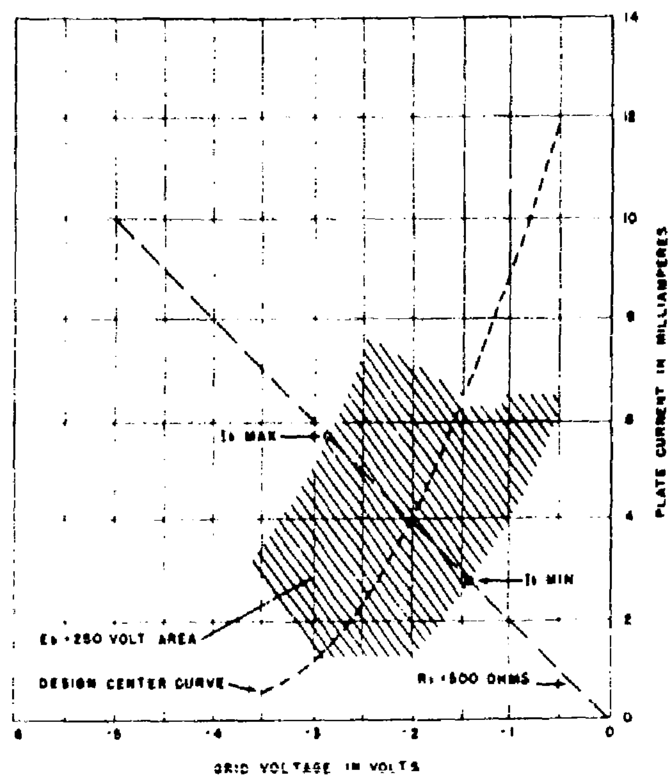


Figure 3-249. Limit Behavior of Tube Type JAN-5744WA Transfer Data

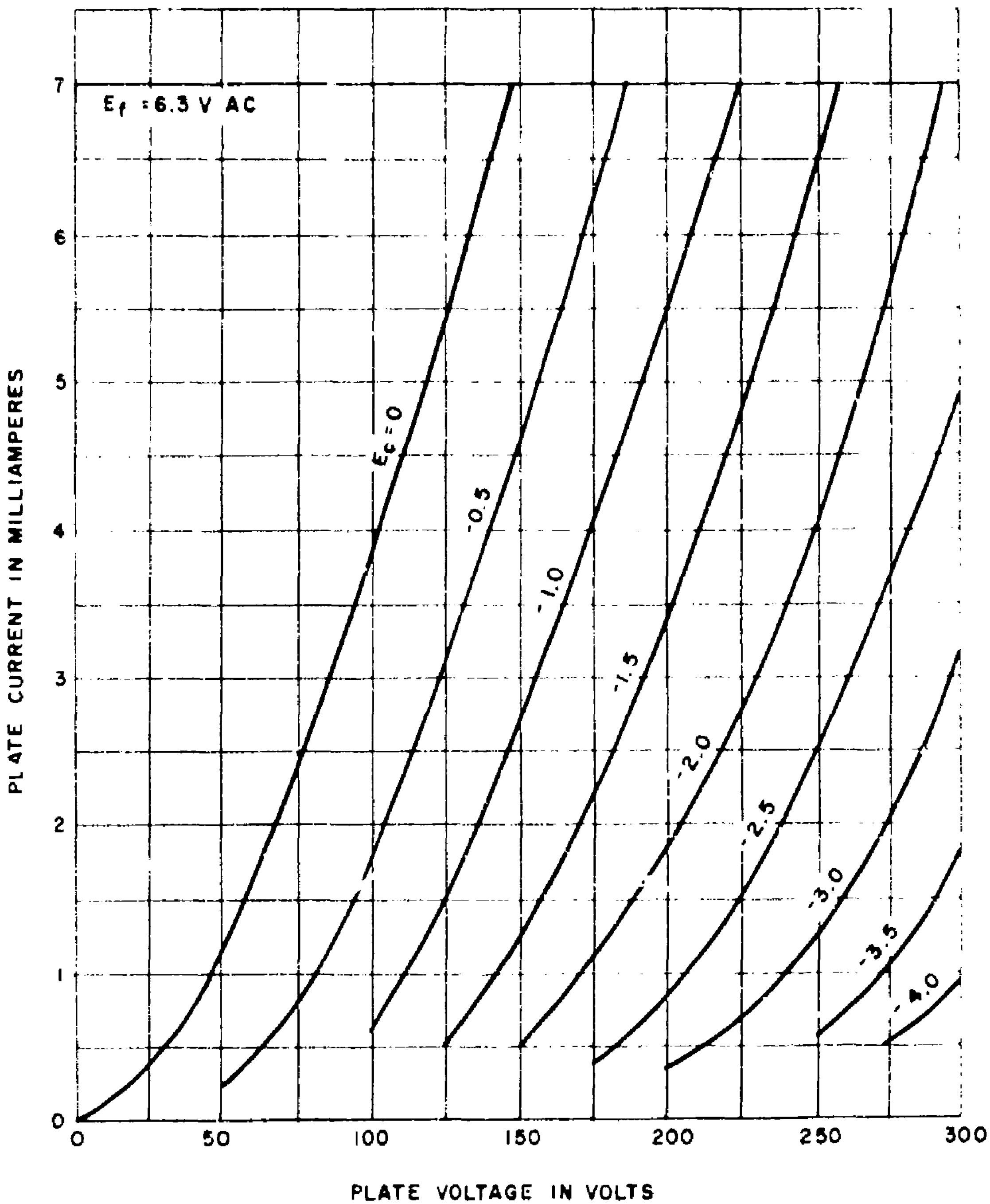


Figure 3-250. **Typical Static Plate Characteristics of Tube Type JAN-5744WA**

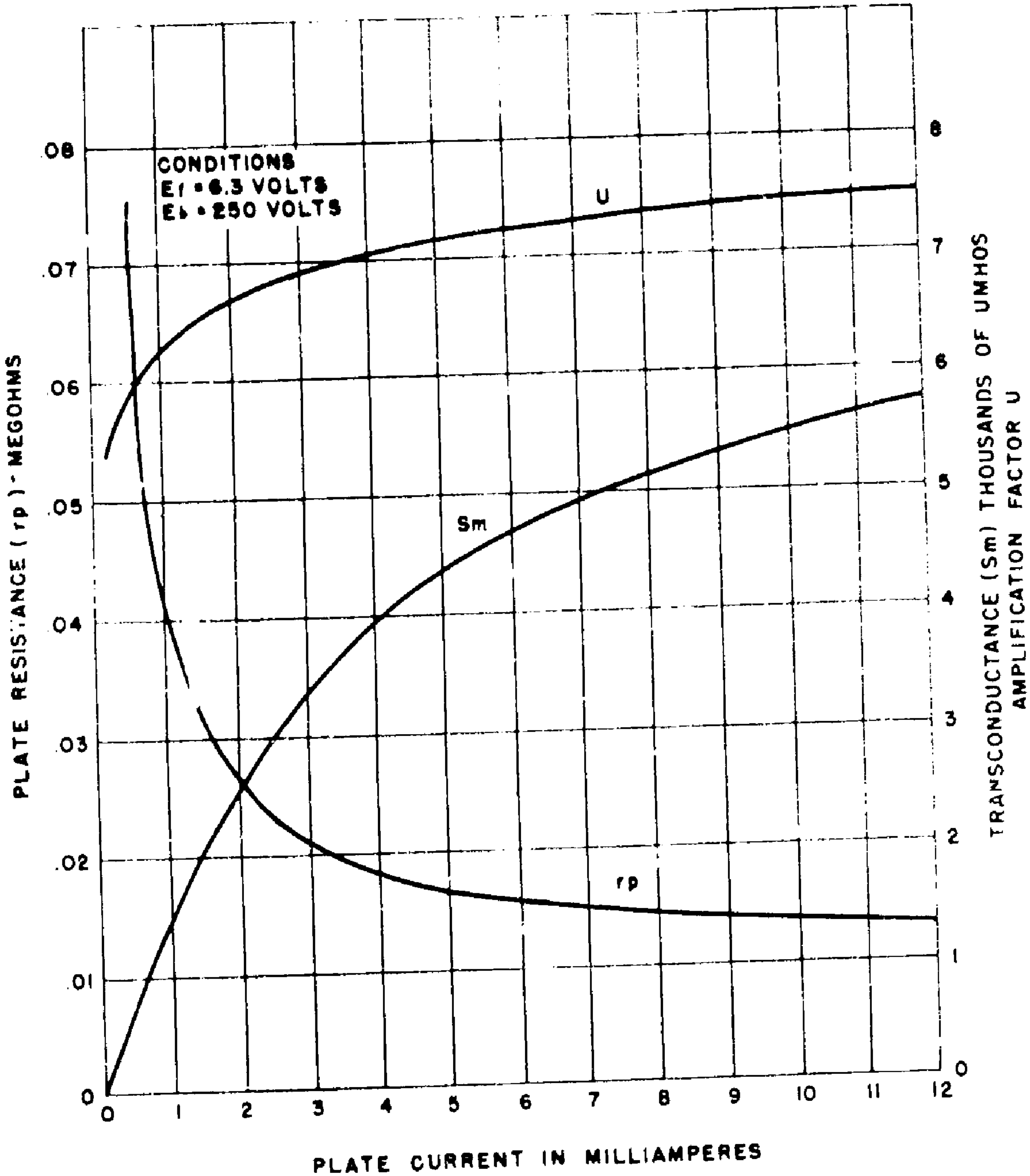


Figure 3-251. Typical Sm, rp and u Characteristics of Tube Type JAN-5744WA

SECTION 42

TUBE TYPE JAN-5749/6BA6W

3.42 DESCRIPTION.

3.42.1 The JAN-5749/6BA6W 1/ is a 7 pin miniature, remote cutoff pentode.

3.42.2 ELECTRICAL. The electrical characteristics are as follows:
Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 300 ma
Cathode . . . . Coated Unipotential

3.42.3 MOUNTING. Not specified.

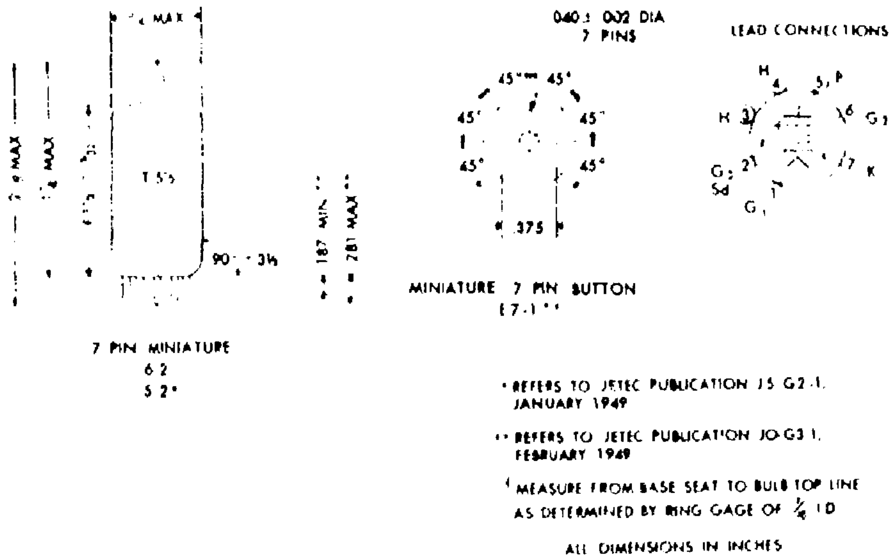


Figure 3-252. Outline Drawing and Base Diagram of Tube Type JAN-5749/6BA6W

3.42.4 RATINGS, ABSOLUTE SYSTEM.

3.42.5 The absolute system ratings are as follows:
Heater Voltage . . . . 6.3 ± 10% v
* Plate Voltage . . . . 330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Screen Grid Voltage . . . . 150 Vdc
Heater Cathode Voltage . . . . ±100 v

1/ The values and specification comments presented in this section are related to MIL-E-1/8 dated 13 January 1953.

* No test at this rating exists in the specification.

* Plate Dissipation . . . . 3.3 W
* Screen Grid Dissipation . . . . 0.7 W
* Bulb Temperature . . . . 165°C
* Altitude Rating . . . . 10,000 ft

3.42.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.42.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef . . . . 6.3 V
Plate Voltage, Eb . . . . 250 Vdc
Control Grid Voltage, Ec . . . . 0 Vdc
Screen Grid Voltage, Ec2 . . . . 100 Vdc
Suppressor Grid Voltage, Ec3: Tie grid 3 to negative terminal of cathode resistor
Cathode Resistance, Rk . . . . 68 ohms
Heater Current, If . . . . 300 mA
Plate Current, Ib . . . . 11 0 mA
Transconductance, Sm . . . . 4400 umhos
Transconductance, Sm at Ec1 = -20, Rk-0 . . . 40 umhos

3.42.8 ACCEPTANCE TEST LIMITS.

3.42.9 Table 3-68 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/8 dated 13 January 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.42.10 APPLICATION.

3.42.11 The chart below shows the permissible operating area for JAN-5749/6BA6W as defined by the ratings in MIL-E-1/8 dated 13 January 1953. A discussion of the permissible operating area for pentodes may be found in paragraphs 3.2.2 through 3.2.7.

---

* No test of operation at this rating exists in the specification.

TABLE 3-68. ACCEPTANCE TEST LIMITS OF JAN-5749/6BA6W

PROPERTY	MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIFE TEST MIN	LIFE TEST MAX	UNITS
Heater Current If		275	325	275	325	mA
Transconductance (1) Sm		3600	5200	3000	5200	umhos
Average change Avg $\Delta \frac{Sm}{t}$		---	---	---	17	%
Transconductance (2) Sm	Ef = 5.5 V	3100	---	---	---	umhos
Transconductance (3) Sm	Ecl = -20 Vdc; Rk = 0; Ck = 0	5	100	---	---	umhos
Plate Current Ib		8.5	13.5	---	---	mAdc
Screen Current Ic2		---	5.6	---	---	mAdc
Capacitance Cgl-p	Ef = 0	---	.0035	---	---	uuf
(Without shield) Cin	Ef = 0	4.4	6.6	---	---	uuf
Cout	Ef = 0	3.5	6.5	---	---	uuf
Grid Current Icl	Ecl = -1.0 Vdc Rgl = .25 Meg	---	-1.0	---	-1.0	uAdc
Heater-Cathode Ihk	Ehk = +100 Vdc	---	10	---	10	uAdc
Leakage Ihk	Ehk = -100 Vdc	---	-10	---	-10	uAdc

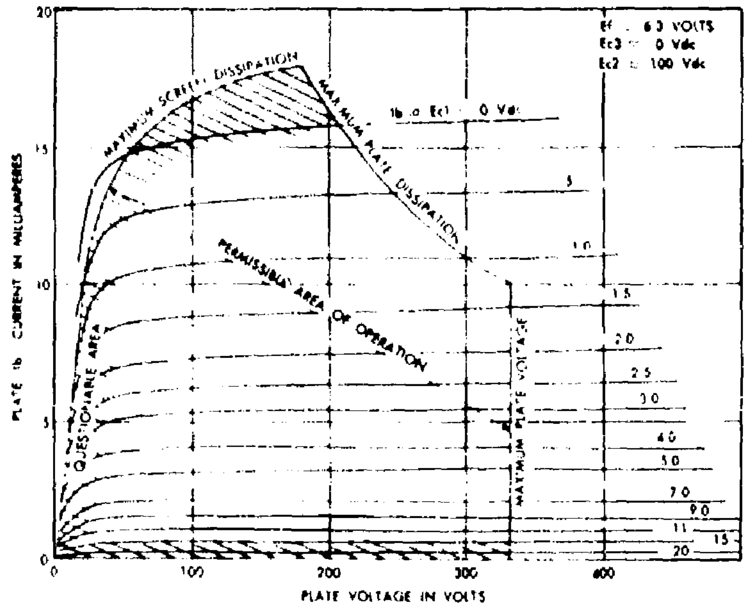


Figure 3-253. Typical Plate Characteristics of JAN-5749/6BA6W; Permissible Area of Operation

3.42.12 Table 3-69 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this manual.

3.42.13 VARIABILITY OF CHARACTERISTICS.

3.42.14 The following charts show the amount of variation which may be expected among individual tubes. The variability boundaries of these were determined from the acceptance limits given on the specification.

3.42.15 Figure 3-254 presents the limit behavior of static plate characteristics for JAN-5749/6BA6W as defined by MIL-E-1/8 dated 13 January 1953.

TABLE 3-69. APPLICATION PRECAUTIONS FOR JAN-5749/6BA6W

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Brid Bias:
- Low 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15
- Fixed, 1.3.8, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44,
Microphonics, 1.3.56, 3.2.23

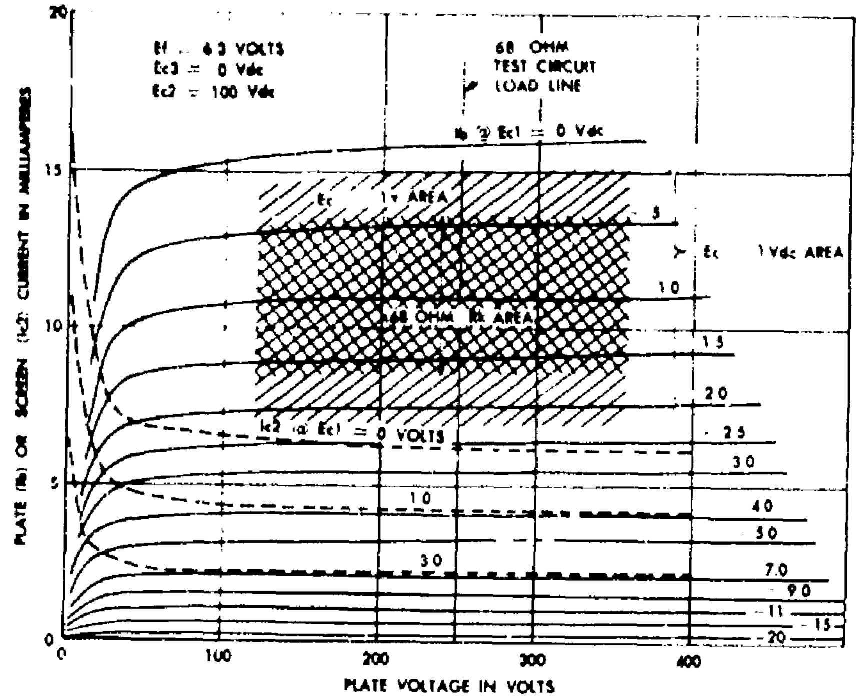


Figure 3-254. Limit Plate Characteristics of JAN-5749/6BA6W; Variability of Ib

3.42.16 Figure 3-255 presents the limit behavior of plate transfer data for JAN-5749/6BA6W as defined by MIL-E-1/8 dated 13 January 1953.

3.42.17 DESIGN CENTER CHARACTERISTICS.

3.42.18 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.42.19 Figure 3-256 presents the Static Plate Characteristics of JAN-5749/6BA6W.

3.42.20 Figures 3-257, 258 and 259 present typical transfer characteristics of JAN-5749/6BA6W.

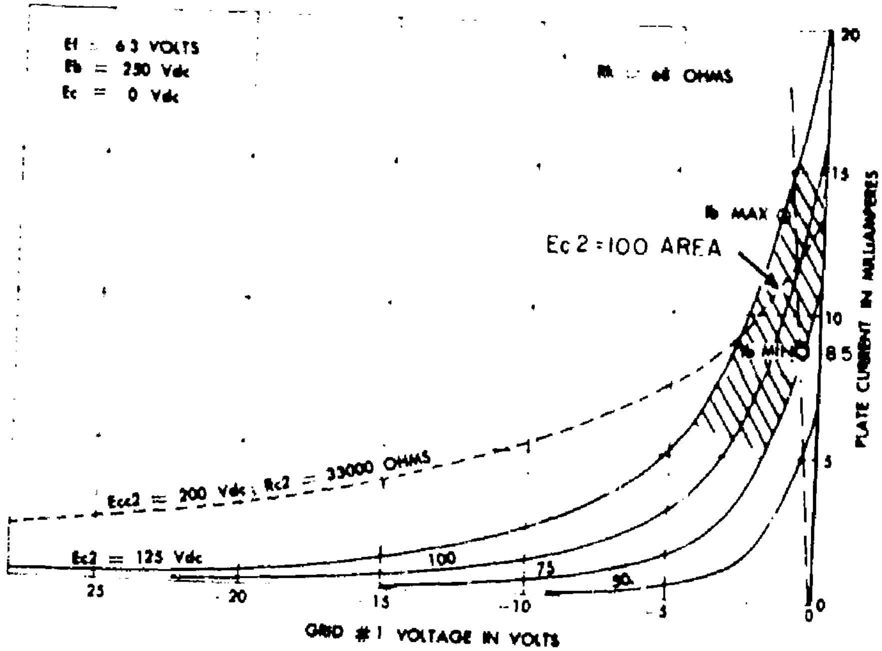


Figure 3-255. Limit Transfer Characteristics of JAN-5749/6BA6W

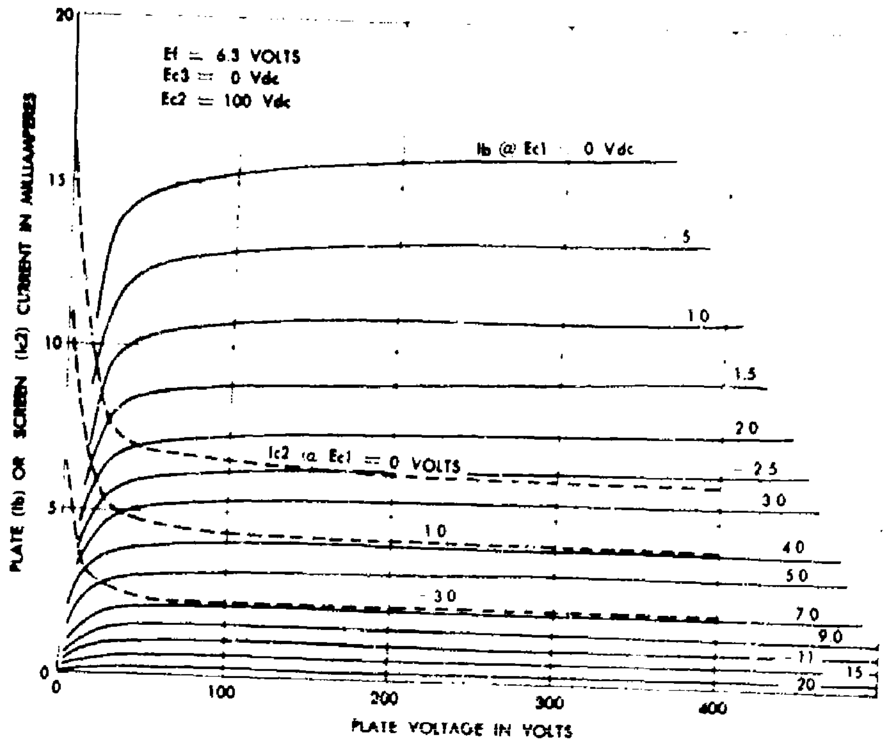


Figure 3-256. Typical Plate and Screen Characteristics of JAN-5749/6BA6W

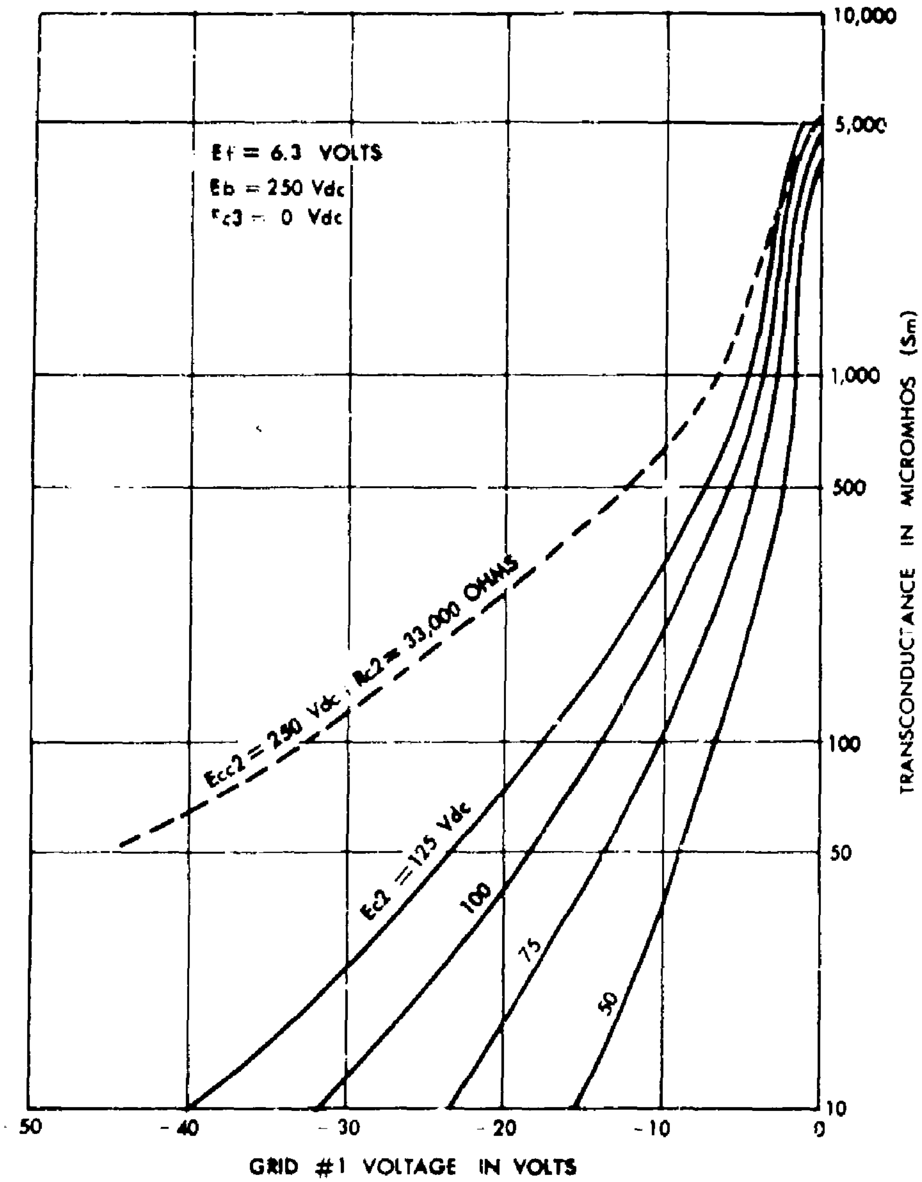


Figure 3-257. Typical JAN-5749/6BA6W Characteristics; Sm as a Function of Ec1; Parametric in Ec2

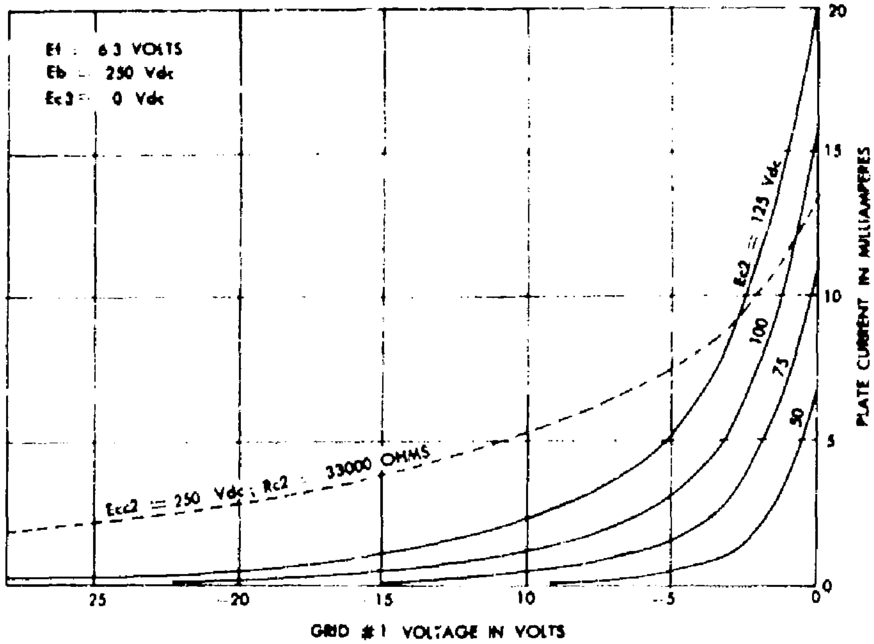


Figure 3-258. Typical Transfer Characteristics of JAN-5749/6BA6W

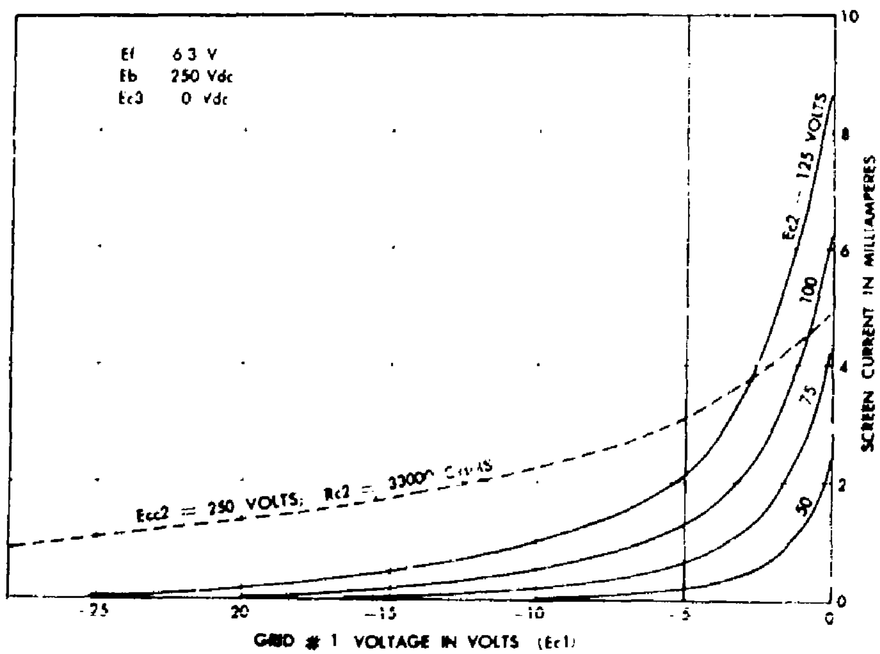


Figure 3-259. Typical Screen Transfer Characteristics of JAN-5749/6BA6W

SECTION 43

TUBE TYPE JAN-5751

3.43 DESCRIPTION.

3.43.1 The JAN-5751 1/ is a 9-pin, miniature, high Mu (70), twin triode having separate cathode connections. The heater may be connected for either series or parallel operation.

3.43.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 12.6 or 6.3 V
Heater Current, Design Center . . . . 175 mA
Cathode . . . . Coated Unipotential

3.43.3 MOUNTING. Not specified.

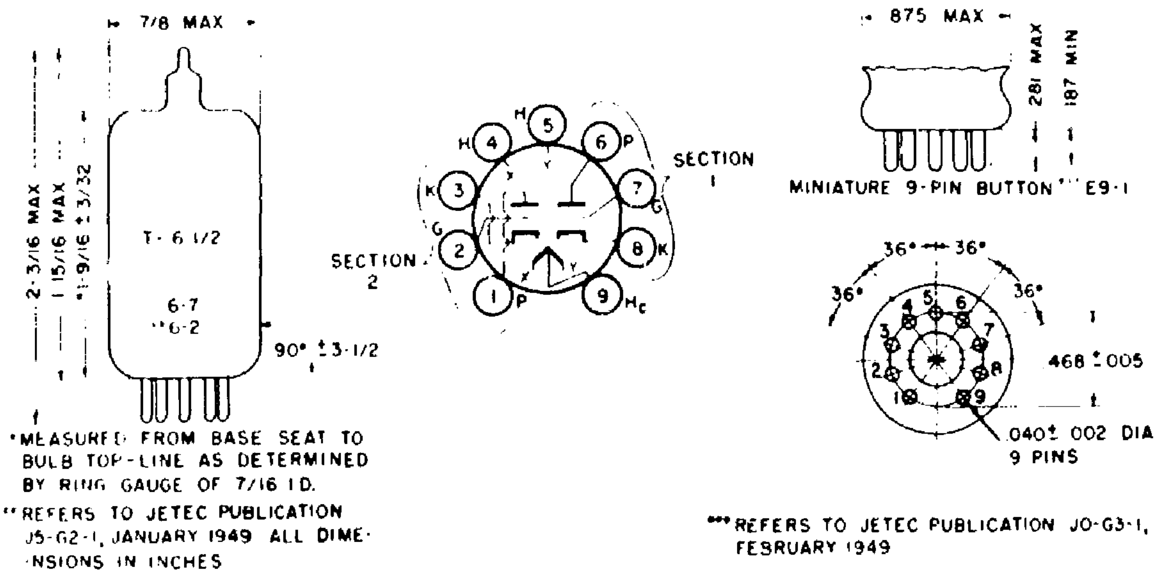


Figure 3-260. Outline Drawing and Base Diagram of Tube Type JAN-5751

1/ The values and specification comments presented in this section are related to MIL-E-1/10 dated 13 January 1953.

3.43.4 RATINGS, ABSOLUTE SYSTEM.

3.43.5 The absolute system ratings are as follows:

Heater Voltage . . . . *6.3 V ± 10% or 12.6 V ± 10%
Plate Voltage . . . . 330 Vdc
Reference MIL-E-1C Section 3.5.1.1 Plate Voltage
Control Grid Voltage, Maximum . . . . 0 Vdc
Control Grid Voltage, Minimum . . . . -50 Vdc
Heater-Cathode Voltage . . . . 100 v
* Plate Dissipation (per plate) . . . . 0.8 W
* Bulb Temperature . . . . 165°C
* Altitude Rating . . . . 10,000 ft

3.43.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.43.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef . . . . 12.6 V
Plate Voltage, Eb . . . . 250 Vdc
Control Grid Voltage, Ec1 . . . . -3 Vdc
Heater Current, If . . . . 175 mA
Plate Current, Ib . . . . 1.0 mAdc
Transconductance, Sm . . . . 1200 umhos
Amplification Factor, Mu 70

3.43.8 ACCEPTANCE TEST LIMITS.

3.43.9 Table 3-70 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/10 dated 13 January 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics unless otherwise indicated.

3.43.10 APPLICATION.

3.43.11 Figure 3-261 shows the permissible operating area for JAN-5751 as defined by the ratings in MIL-E-1/10 dated 13 January 1953. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

3.43.12 Table 3-71 lists general considerations for the application of this type. The numbers refer to the applicable paragraphs of this Manual.

3.43.13 In addition to the considerations noted above, JAN-5751, as reflected in Specification MIL-E-1/10, provides limited assurance of operation in the low plate-voltage, low plate-current region by an acceptance test initially and on life for a-c

* No test of operation at this rating exists in the specification.

amplification using grid leak bias, 100-volt plate supply, and 0.5 megohm plate-load resistance. Any operation in this region other than that described above must be questioned since undesirable effects are common in the low-current and zero-bias regions.

TABLE 3-70. ACCEPTANCE TEST LIMITS OF JAN-5751

PROPERTY	MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIFE TEST MIN	LIFE TEST MAX	UNITS
Heater Current If		160	190	160	190	mA
Transconductance (1) Sm		900	1600	---	- -	umhos
Amplification Factor Mu		55	85	---	---	----
Plate Current (1) Ib		0.4	1.8	---	---	mAdc
Plate Current (1) Ib Difference between sections		---	0.6	---	---	mAdc
Capacitance Cgp	Ef = 0	1.1	1.7	---	---	uuf
(Without shield) Cin	Ef = 0	1.1	1.7	---	---	uuf
Section 1: Cout	Ef = 0	0.23	0.69	---	---	uuf
Section 2: Cout	Ef = 0	0.19	0.53	---	---	uuf
Grid Current Ic	Rg = 1.0 Meg	---	-0.4	---	-0.4	uAdc
Heater-Cathode Leakage Ihk	Ehk= +100 Vdc	---	10	---	10	uAdc
Ihk	Ehk= -100 Vdc	---	-10	---	-10	uAdc
Insulation of Electrodes R(g-all)	Eg-all= -100 Vdc	500	---	250	---	Meg
R(p-all)	Ep-all= -300 Vdc	500	---	250	---	Meg
AC Amplification Ep	Eb= 100 Vdc; Ec= 0 Esig= 0.2 Vac Rp= 0.5 Meg Rg= 10 Meg	7.5	---	6.5	---	Vac

3.43.14 VARIABILITY OF CHARACTERISTICS.

3.43.15 The following charts show variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

TABLE 3-71. APPLICATION PRECAUTIONS FOR JAN-5751

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
  High, 3.1.8
  Low, 3.1.15
  AC Operation, 1.3.20, 3.1.10
  28 Volt, 3.1.15
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.1.3
  Cathode, 2.1.3, 3.1.12
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.14, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.43.16 Figure 3-262 presents the limit behavior of static plate characteristics for JAN-5751 as defined by MIL-E-1/10 dated 13 January 1953.

3.43.17 Figure 3-263 presents the limit behavior of plate transfer data for JAN-5751 as defined by MIL-E-1/10 dated 13 January 1953.

3.43.18 DESIGN CENTER CHARACTERISTICS.

3.43.19 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.43.20 Figure 3-264 presents the static plate characteristics for JAN-5751.

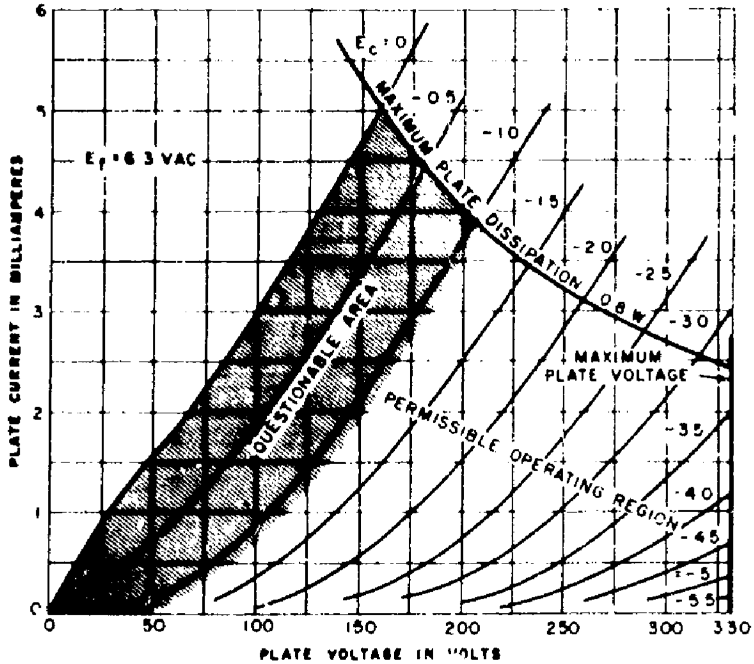


Figure 3-261. Typical Static Plate Characteristics of Tube Type JAN-5751; Permissible Area of Operation

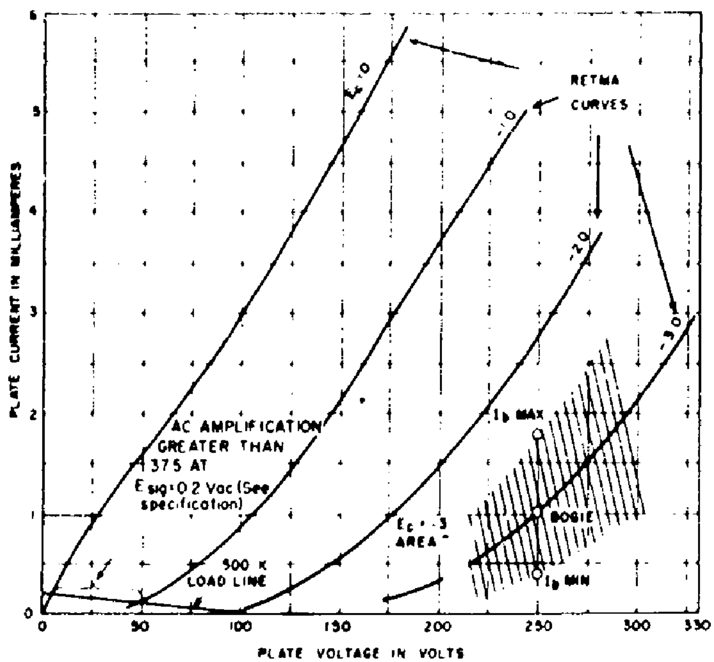


Figure 3-262. Limit Behavior Static Plate Characteristics of Tube Type JAN-5751

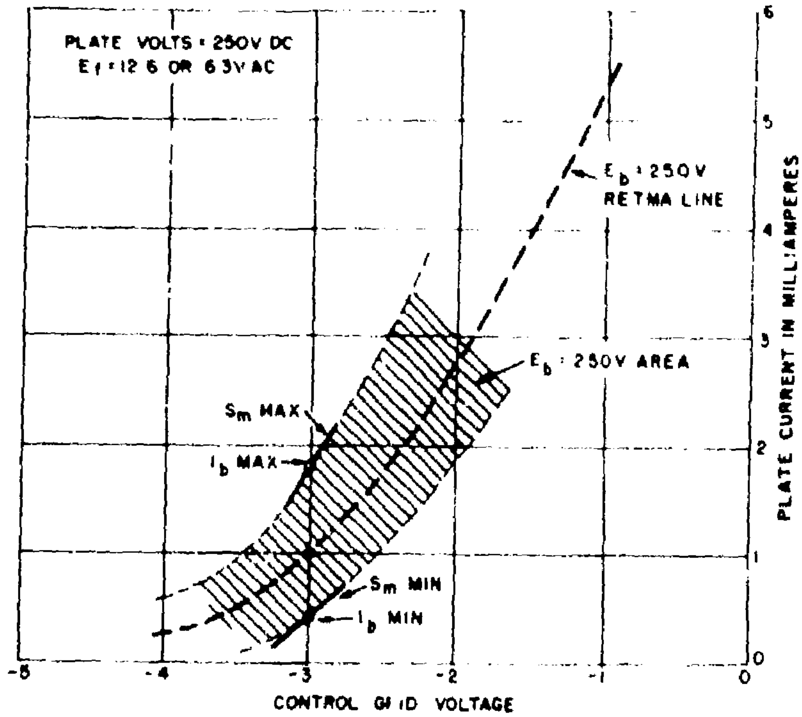


Figure 3-263. Limit Behavior of Transfer Data for Tube Type JAN-5751

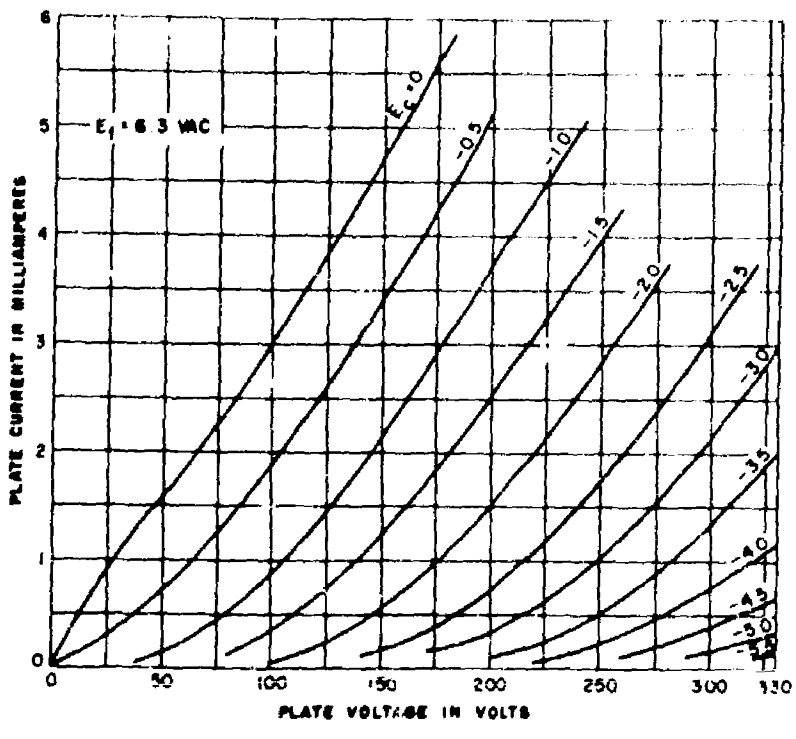


Figure 3-264. Typical Static Plate Characteristics of Tube Type JAN-5751

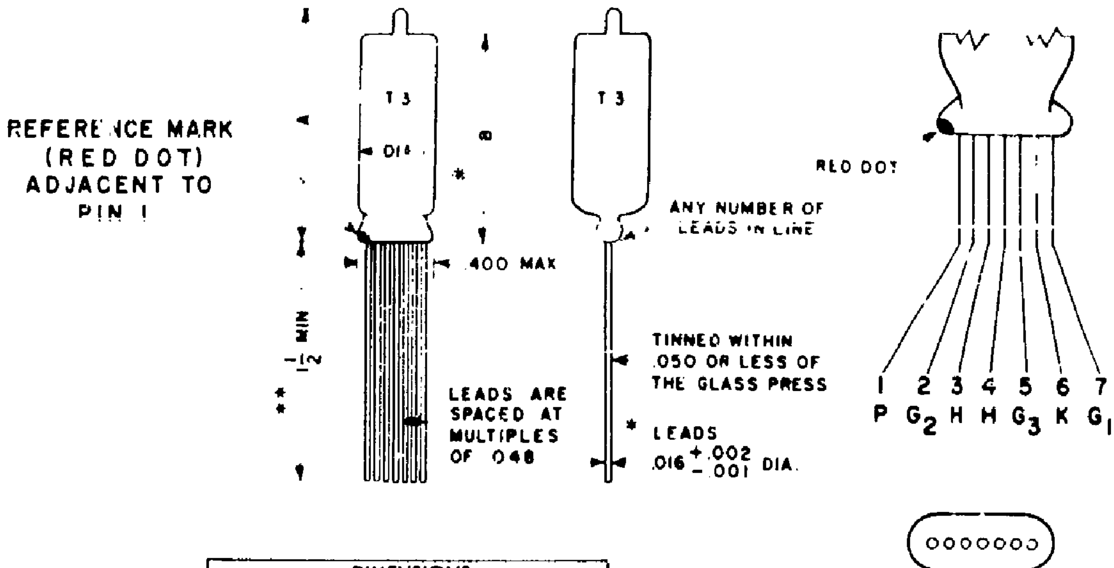
TUBE TYPE JAN-5784WA

3.44 DESCRIPTION.

3.44.1 The JAN-5784WA 1/ is a flat-press, seven-lead, subminiature, dual-control, pentode having a design center transconductance value of 3200 micromhos.

3.44.2 ELECTRICAL. The electrical characteristics are as follows:
Heater Voltage . . . . 6.3 V
Heater Current . . . . .183 to 217 mA
Cathode . . . . Coated Unipotential

3.44.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B DIM	B TOL. ±	DIAMETER MAX
1.500	1.250	.100	.400

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-265. Outline Drawing and Base Diagram of Tube Type JAN-5784WA

1/ The values and specification comments presented in this section are related to MIL-E-1/88B dated 23 August 1955.

3.44.4 RATINGS, ABSOLUTE SYSTEM.

3.44.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 0.6 V
Plate Voltage	200 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Screen Voltage	155 Vdc
Suppressor Grid Voltage	30 Vdc
* Plate Dissipation	1.85 W
* Screen Dissipation	0.85 W
Heater-Cathode Voltage	200 v
* Cathode Current, Maximum	20 mAdc
* Cathode Current, minimum	0.5 mAdc
* Bulb Temperature	265°C
Altitude Rating	60,000 ft

3.44.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.44.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	120 Vdc
Control Grid Voltage, Ec1	-2.0 Vdc
Screen Grid Voltage, Ec2	120 Vdc
Suppressor Grid Voltage, Ec3	0 Vdc
Heater- Cathode Voltage	0 Vdc
Plate Current, Ib	5.2 mAdc
Transconductance, Sm	3200 umhos

3.44.8 ACCEPTANCE TEST LIMITS.

3.44.9 Table 3-72 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/88B dated 23 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test at this rating exists in the specification.

Table 3-72. ACCEPTANCE TEST LIMITS OF JAN-5784WA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		183	217	183	217	mA
Transconductance (1)	Sm		2500	4500	---	---	umhos
Change in individuals	$\Delta \frac{Sm}{t}$		---	---	---	25	%
Transconductance (2)	$\Delta \frac{Sm}{Ef}$		---	15	---	20	%
Plate Current (1)	Ib		2.5	9.0	---	---	mAdc
Plate Current (2)	Ib	Ec3 = -15 Vdc	---	20	---	---	uAdc
Screen Grid Current	Ic2		0	7.0	---	---	mAdc
Capacitance	Cglp	Ef 0	---	0.030	---	---	uuf
(Shielded as	Cin	Ef = 0	3.5	5.5	---	---	uuf
Specified)	Cout	Ef 0	2.8	4.4	---	---	uuf
Grid Current (1)	Ic		0	-0.7	0	-0.9	uAdc
Heater-Cathode	Ihk	Ehk = 100 Vdc	---	10	---	20	uAdc
Leakage	Ihk	Ehk = -100 Vdc	---	-10	---	-20	uAdc
Electrodes	R(g-all)	Eg1-all = -100Vdc	100	---	50	---	Meg
Insulation	R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg
	R(g3-all)	Eg3-all = -100 Vdc	100	---	50	---	Meg

3.44.10 APPLICATION.

3.44.11 Figure 3-266 shows the permissible operating area for JAN-5784WA as defined by the ratings in MIL-E-1/88B dated 23 August 1955. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.44.12 Table 3-73 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

3.44.13 VARIABILITY OF CHARACTERISTICS.

3.44.14 The following charts define the extent of variation which may be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

TABLE 3-74 APPLICATION PRECAUTIONS FOR JAN-5784WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.44.15 Figure 3-267 presents the limit behavior of static plate characteristics for JAN-5784WA as defined by MIL-E-1/88B dated 23 August 1955.

3.44.16 Figure 3-268 presents the limit behavior of static screen grid characteristics for JAN-5784WA.

3.44.17 Figure 3-269 presents the limit behavior of plate transfer data for JAN-5784WA as defined by MIL-E-1/88B dated 23 August 1955.

3.44.18 Figure 3-270 presents the limit behavior of screen grid transfer data for JAN-5784WA.

3.44.19 DESIGN CENTER CHARACTERISTICS.

3.44.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.44.21 Figure 3-271 presents the static plate characteristics of JAN-5784WA.

3.44.22 Figure 3-272 presents the typical plate transfer data for JAN-5784WA.

3.44.23 Figure 3-273 presents the typical suppressor transfer data for JAN-5784WA.

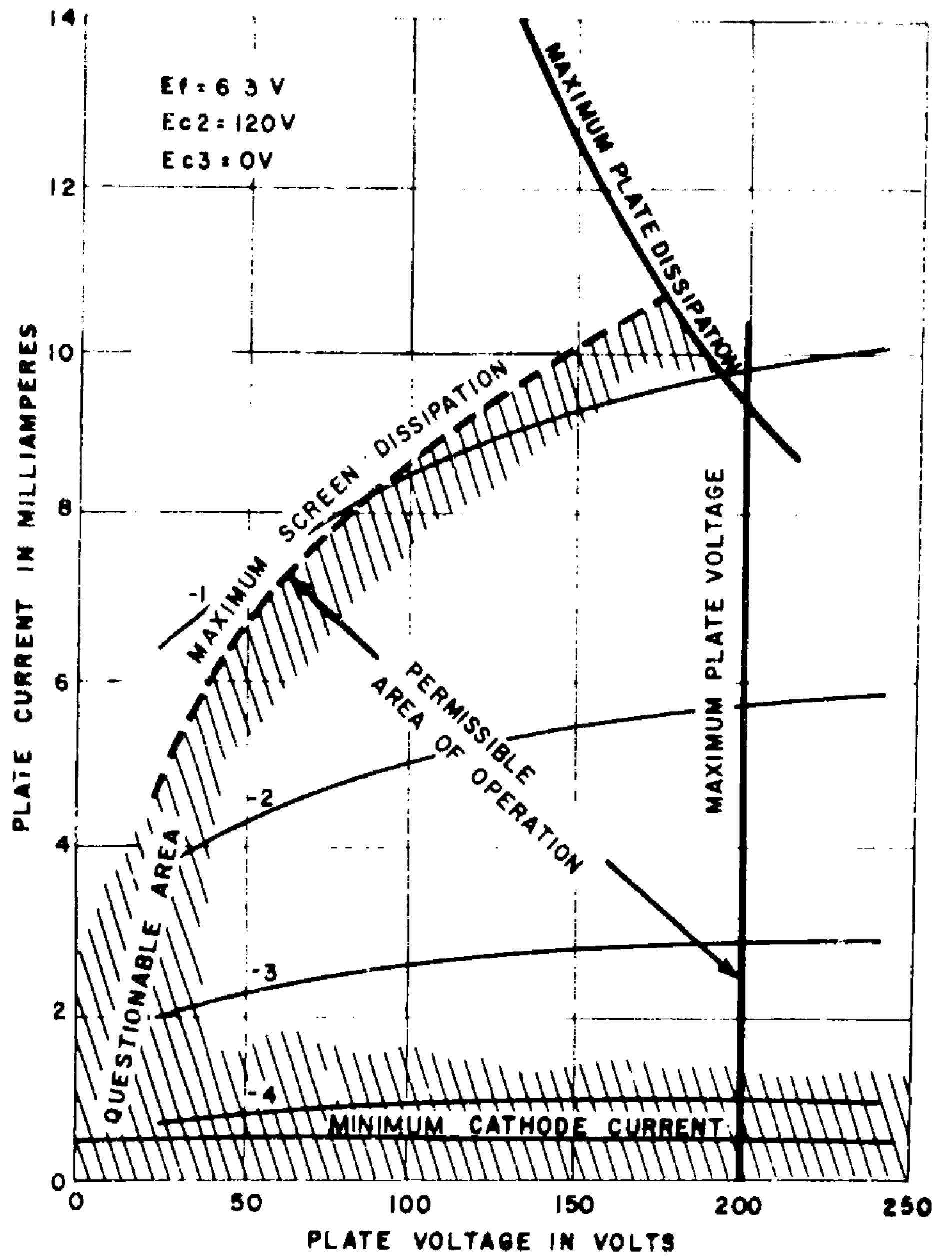


Figure 3-266. Typical Static Plate Characteristics of Tube Type JAN-5784WA; Permissible Area of Operation

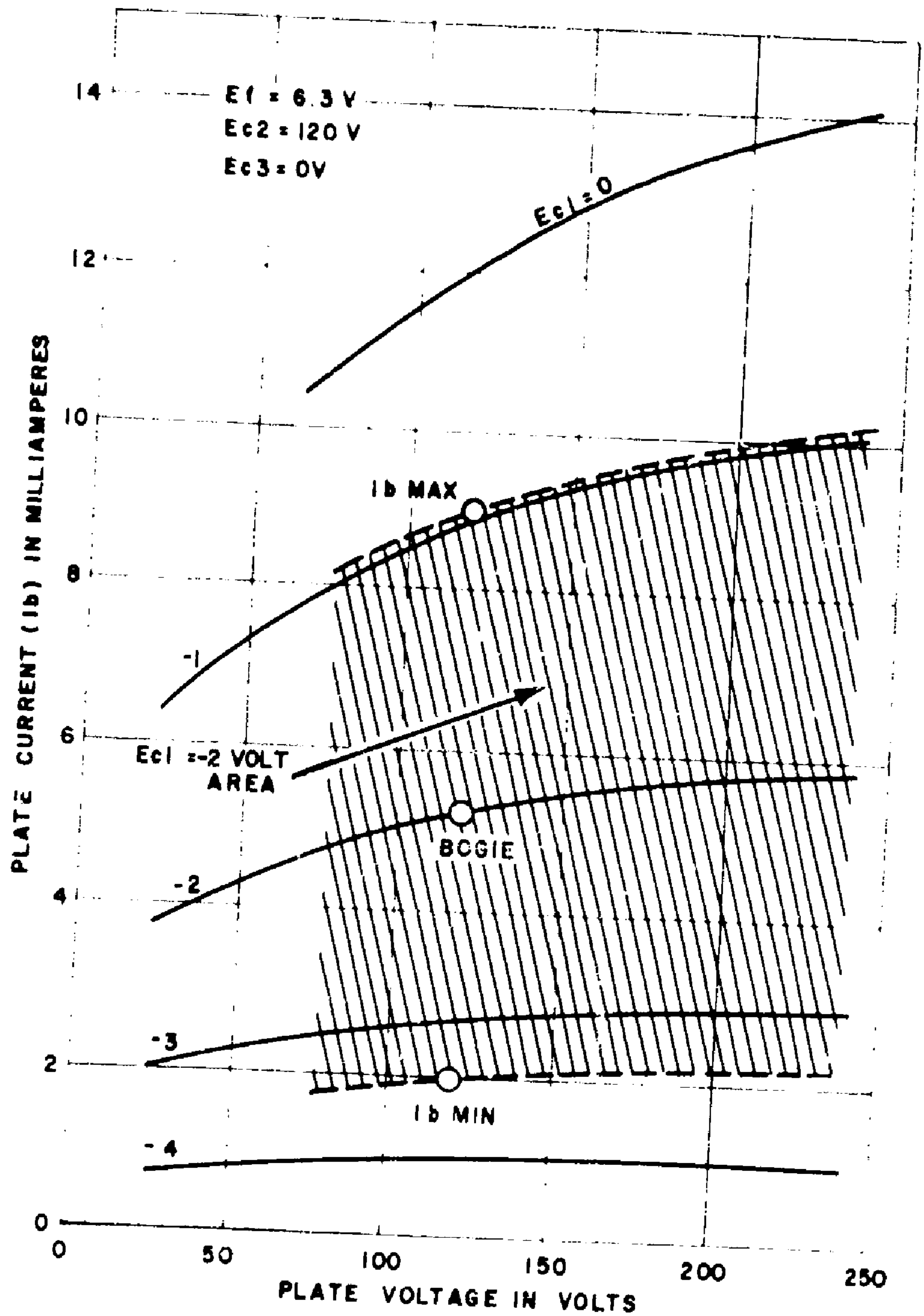


Figure 3-267. Limit Plate Characteristics of Tube Type JAN-5784WA; Variability of Ib

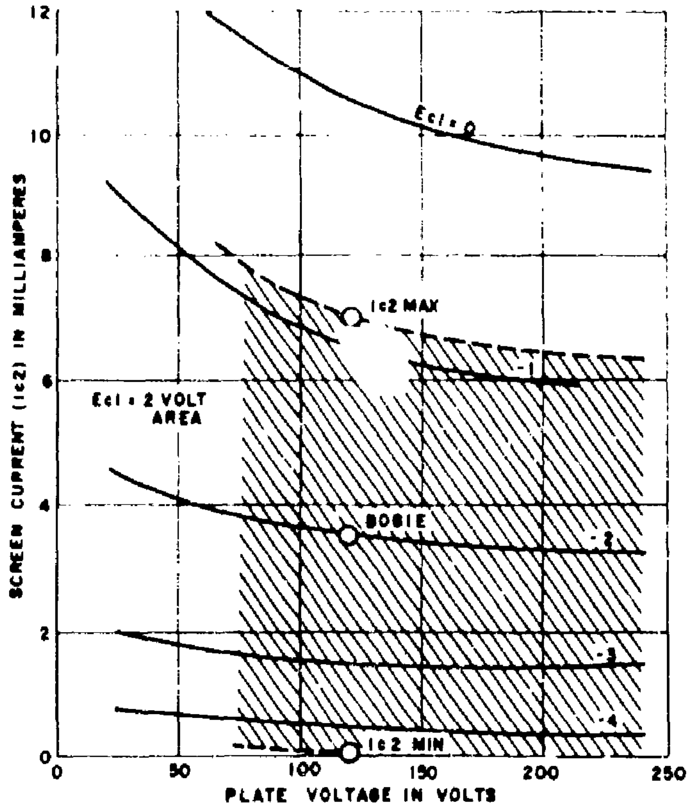


Figure 3-268. Limit Plate Characteristics of Tube Type JAN-5784WA; Variability of Ic2

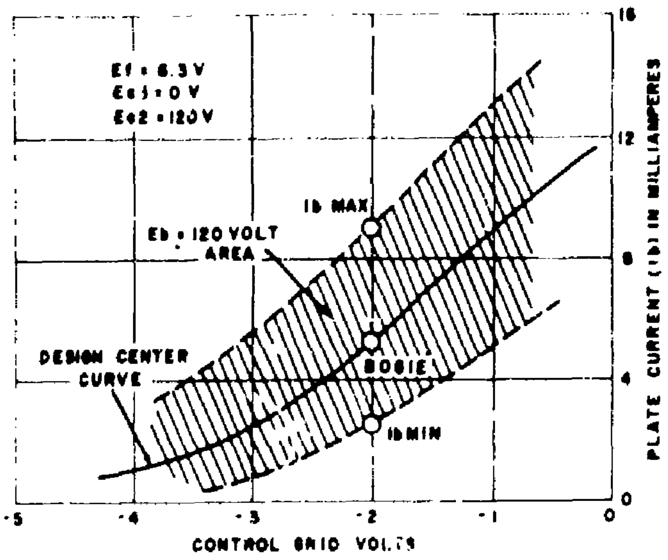


Figure 3-269. Typical Transfer Characteristics of Tube Type JAN-5784WA; Variability of Ib

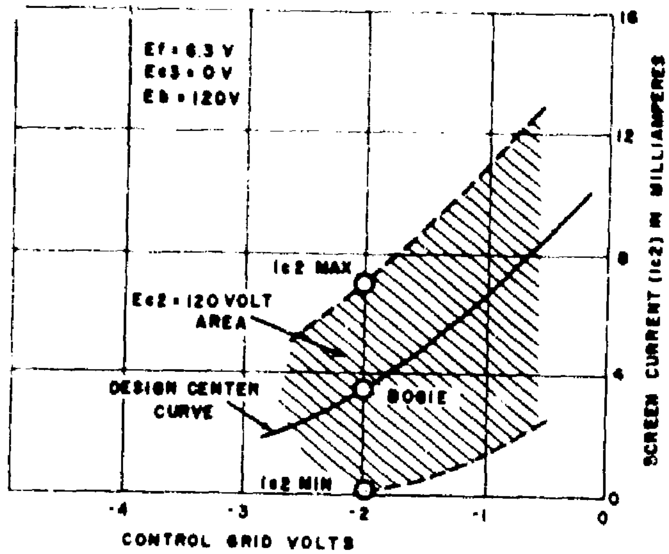
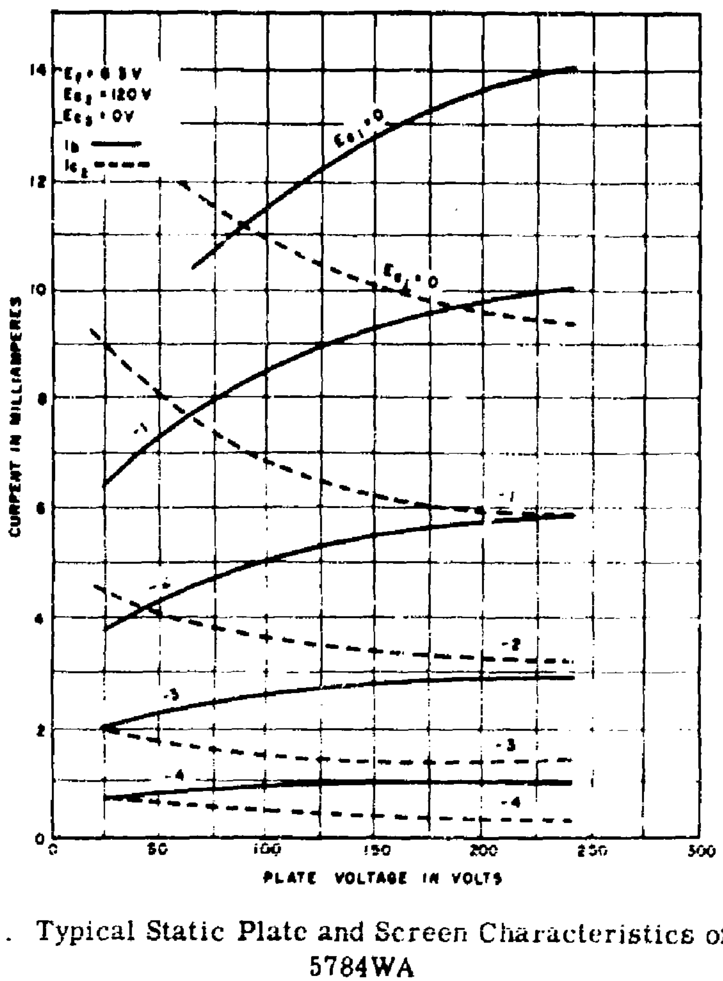


Figure 3-270. Limit Screen Transfer Characteristics for Tube Type JAN-5784WA; Variability of Ic2



WA;

Figure 3-271. Typical Static Plate and Screen Characteristics of Tube Type JAN-5784WA

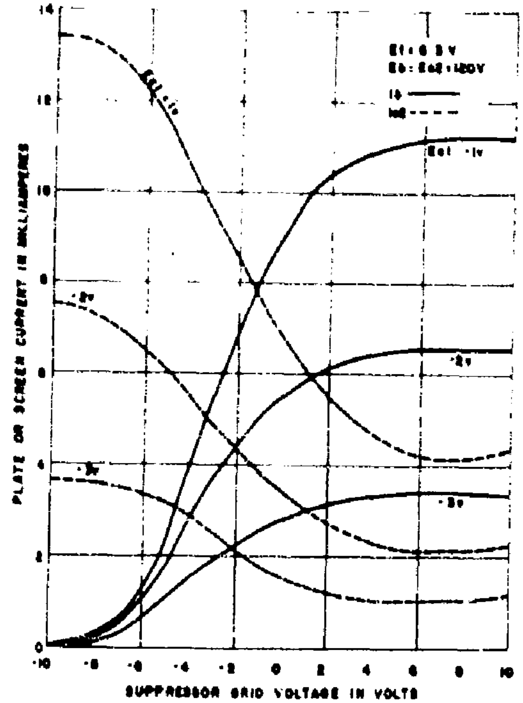


Figure 3-272. Typical Suppressor Transfer Characteristics for Tube Type JAN-5784WA

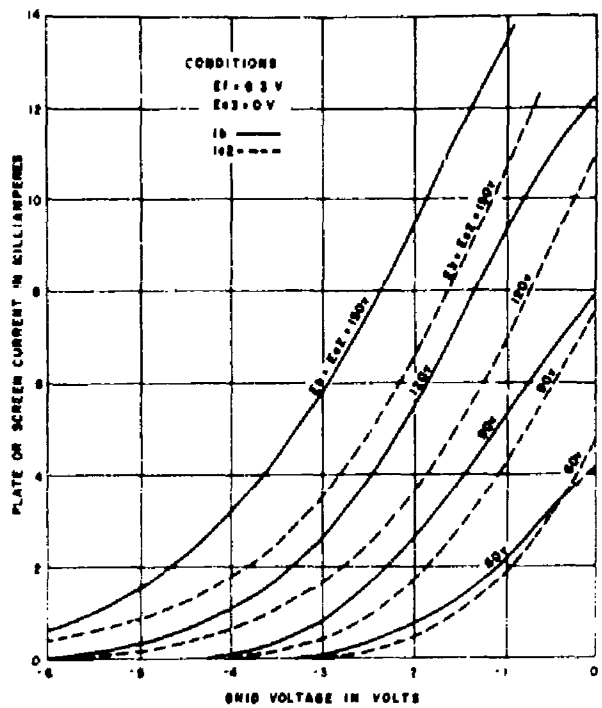


Figure 3-273. Typical Transfer Characteristics for Tube Type JAN-5784WA

SECTION 45

TUBE TYPE JAN-5814A

3.45 DESCRIPTION.

3.45.1 The JAN-5814A 1/ is a 9 pin miniature medium-mu twin triode having separate cathode connections. The heater may be connected for either series or parallel operation.

3.45.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 12.6 or 6.3 V
Heater Current, Design Center . . . . 175 or 350 mA
Cathode . . . . Coated Unipotential

3.45.3 MOUNTING. Not specified.

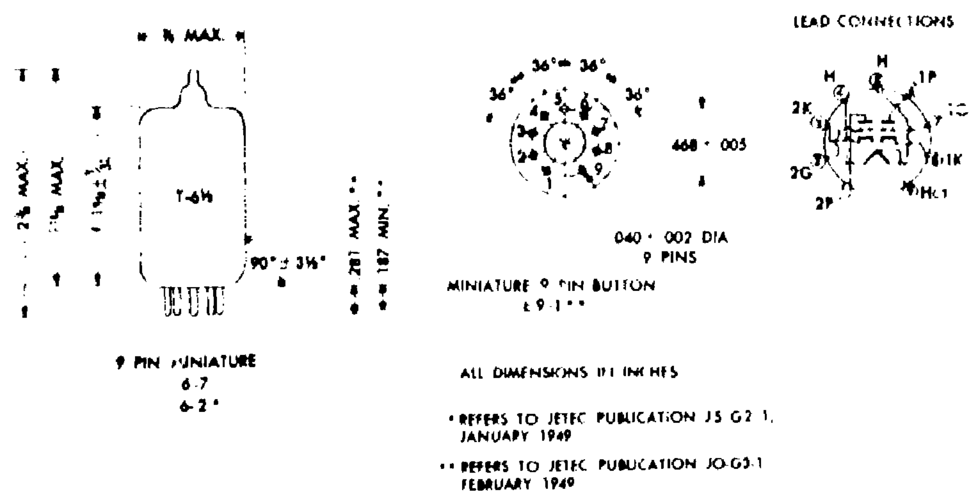


Figure 3-274. Outline Drawing and Base Diagram of Tube Type JAN-5814A

3.45.4 RATINGS, ABSOLUTE SYSTEM.

3.45.5 The absolute system ratings are as follows:

Heater Voltage . . . . 6.3 ± .6 or 12.6 ± 1.3 V
* Plate Voltage . . . . 330 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Grid Voltage, Maximum . . . . 0 Vdc
* Grid Voltage, Minimum . . . . -55 Vdc
Heater-Cathode Voltage . . . . 100 v
Grid Series Resistance (per grid) . . . . 0.5 Meg
* Cathode Current (per cathode) . . . . 22 mA
* Grid Current (per grid) . . . . 5 mA

* No test at this rating exists in the specification.

1/ The values and specification comments presented in this section are related to MIL-E-1/12A dated 23 December 1955.

Plate Dissipation (per plate) . . . . 3.0 W
Bulb Temperature . . . . 165°C
Altitude Rating . . . . 60,000 ft

3.45.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.45.7 Test conditions and design center characteristics are as follows.

Heater Voltage, Ef . . . . 12.6 V
Plate Voltage, Eb . . . . 250 Vdc
Grid Voltage, Ec . . . . -8.5 Vdc
Heater-Cathode Voltage, Ehk . . . . 0 V
Heater Current, If . . . . 175 mA
Plate Current, Ib . . . . 10.5 mA
Transconductance, Sm . . . . 2200 umhos
Amplification Factor, μ 17

3.45.8 ACCEPTANCE TEST LIMITS.

3.45.9 Table 3-74 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/12A dated 23 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.45.10 APPLICATION.

3.45.11 Figure 3-275 shows the permissible operating area for JAN-5814A as defined by the ratings in MIL-E-1/12A dated 23 December 1955. A discussion of the permissible operating area for triodes may be found in paragraphs 3.1.2 through 3.1.6.

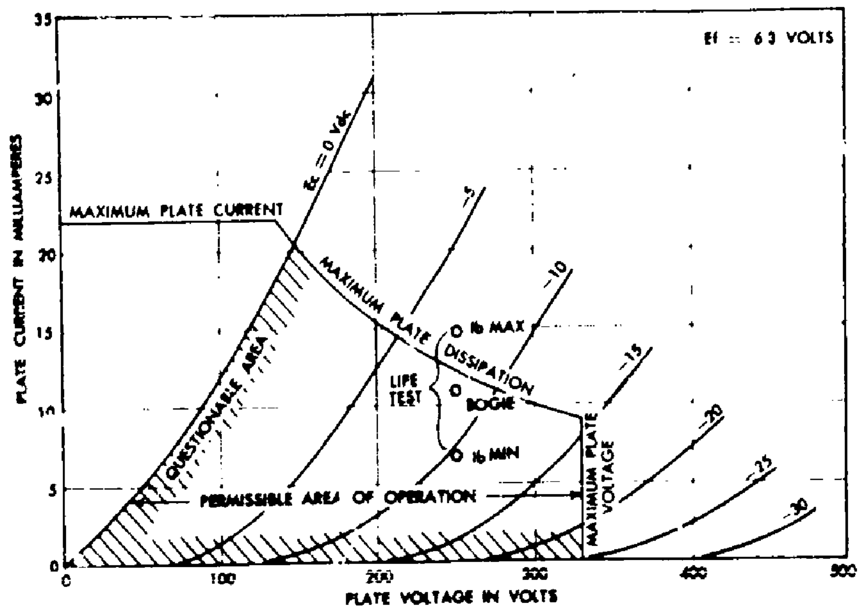


Figure 3-275. Typical Plate Characteristics for JAN-5814A; Permissible Area of Operation

TABLE 3-74. ACCEPTANCE TEST LIMITS OF JAN-5814A

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		160	190	160	193	mA
Transconductance (1)	Sm		1750	2650	---	---	umhos
Change in individuals	Δ_t Sm		---	---	---	15	%
Transconductance (2)	Δ Sm Ef		---	15	---	15	%
Change in Average Avg	Δ Sm t		---	---	---	10	%
Amplification Factor	Mu		15.5	18.5	---	---	
Transconductance (3)	Sm	Eb = 100 Vdc; Ec = 0	2500	4000	---	---	umhos
Plate Current (1)	Ib		6.5	14.5	---	---	mAdc
Plate Current (2)	Ib	Ec = 30 Vdc Rp = 0.1 Meg	---	20	---	---	uAdc
Plate Current (3)	Ib	Ec = -18 Vdc	5	---	---	---	uAdc
Plate Current difference between sections (1)	Ib		---	3.5	---	---	mAdc
Capacitance (no shield)	[illegible]	Ef = 0	1.20	1.80	---	---	uuf
	Cin	Ef = 0	1.25	1.95	---	---	uuf
	Cout1	Ef = 0	0.30	0.70	---	---	uuf
	Cout2	Ef = 0	0.20	0.60	---	---	uuf
Grid Current	Ic	Rg = 0.5 Meg	0	-0.5	0	-0.5	uAdc
Grid Emission	Isc	Ef = 15.0 V Ec = -30 Vdc Rg = 0.5 Meg	---	-1.5	---	--	uAdc
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	---	7	---	7	uAdc
	Ihk	Ehk = -100 Vdc	---	-7	---	-7	uAdc
Insulation of Electrodes	Rg-all	Eg-all = -100 Vdc	500	---	250	---	Meg
	Rp-all	Ep-all = -300 Vdc	500	---	250	---	Meg

3.45.12 Table 3-75 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

TABLE 3-75. APPLICATION PRECAUTIONS FOR JAN-5814A

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
  High, 3.1.8
  Low, 3.1.15
  AC Operation, 1.3.20, 3.1.10
  28 Volt, 3.1.15
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.1.3
  Cathode, 2.1.3, 3.1.12
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.45.13 VARIABILITY OF CHARACTERISTICS.

3.45.14 The following charts show the amount of variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.45.15 Figures 3-276 and 3-277 below present the limit behavior of static plate and transfer characteristics for JAN-5814A as defined by MIL-E-1/12A dated 23 December 1955.

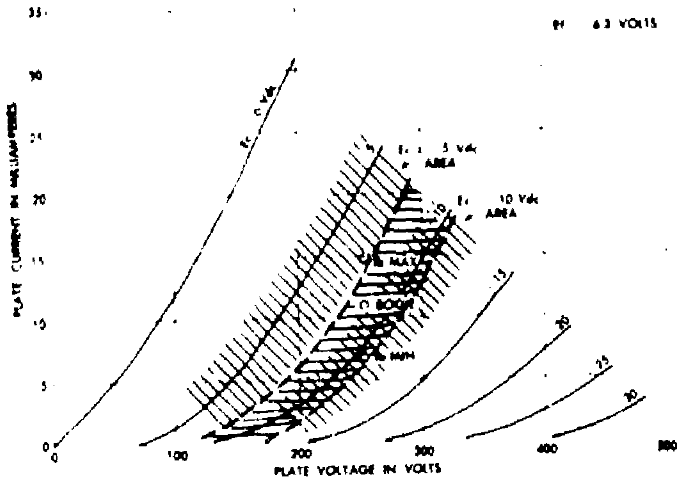


Figure 3-276. Limit Plate Characteristics for JAN-5814A; Variability of Ib

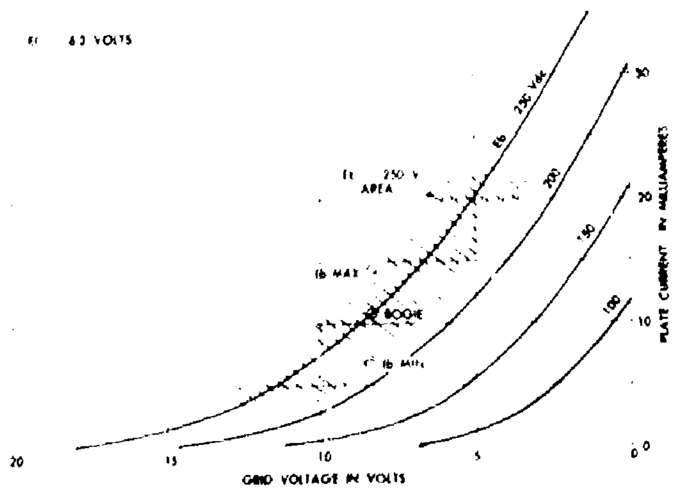


Figure 3-277. Limit Transfer Characteristics fcr JAN-5814A

3.45.16 DESIGN CENTER CHARACTERISTICS OF JAN-5814A.

3.45.17 The typical curves shown in figures 3-278, 279, 280 and 281 have been obtained from current data being published by the original RETMA registrant of this type.

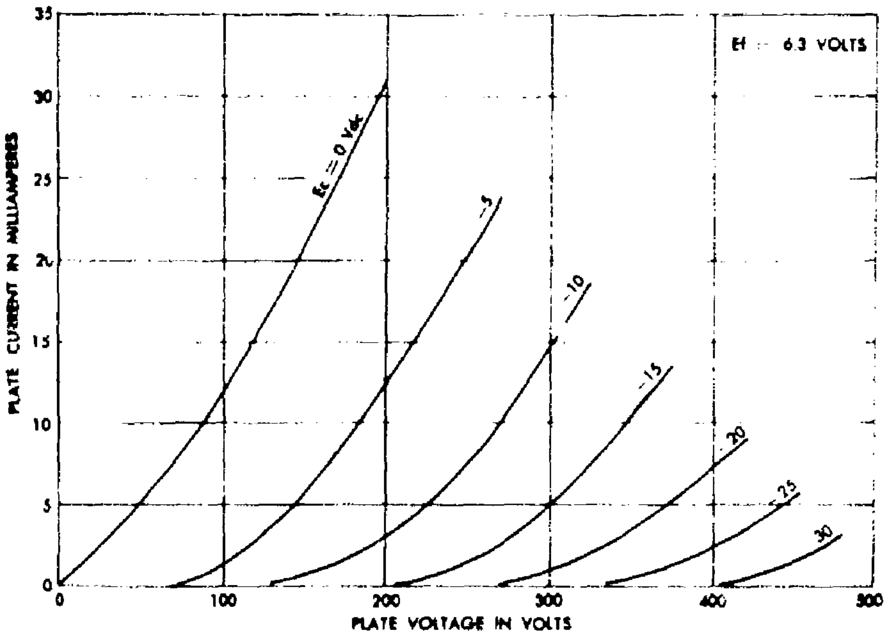


Figure 3-278. Typical Plate Characteristics of JAN-5814A

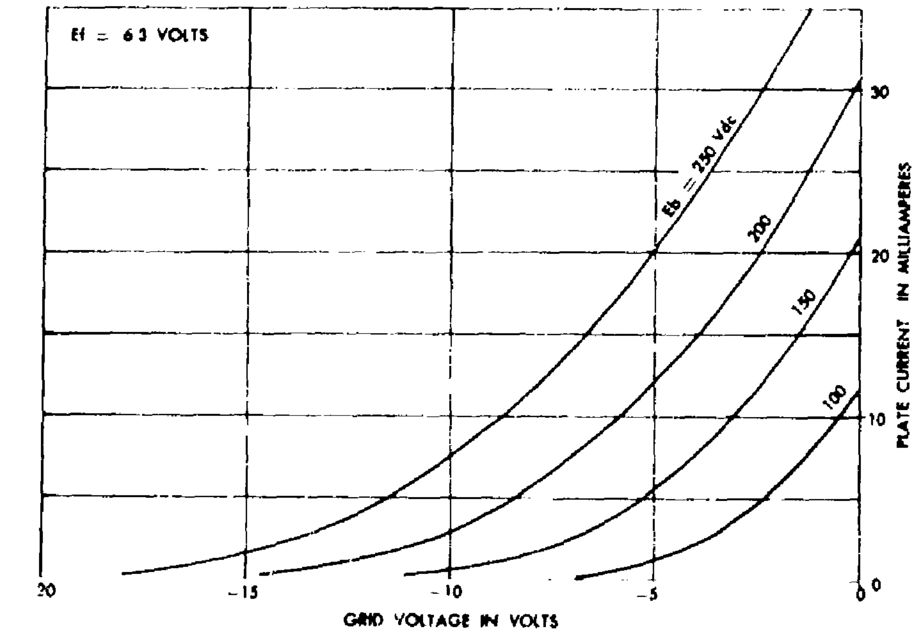


Figure 3-279. Typical Transfer Characteristics for JAN-5814A

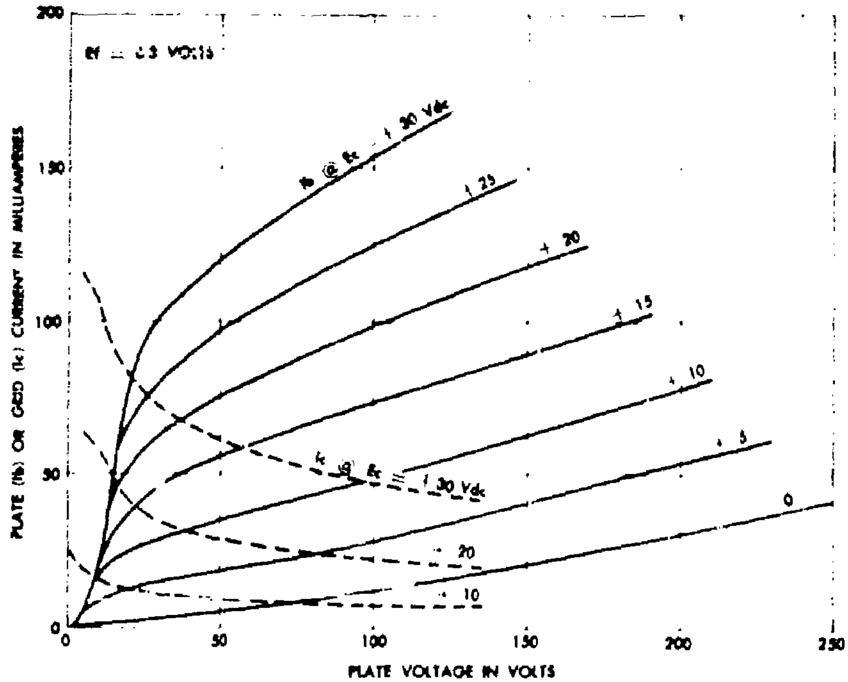


Figure 3-280. Typical Plate and Grid Characteristics for JAN-5814A

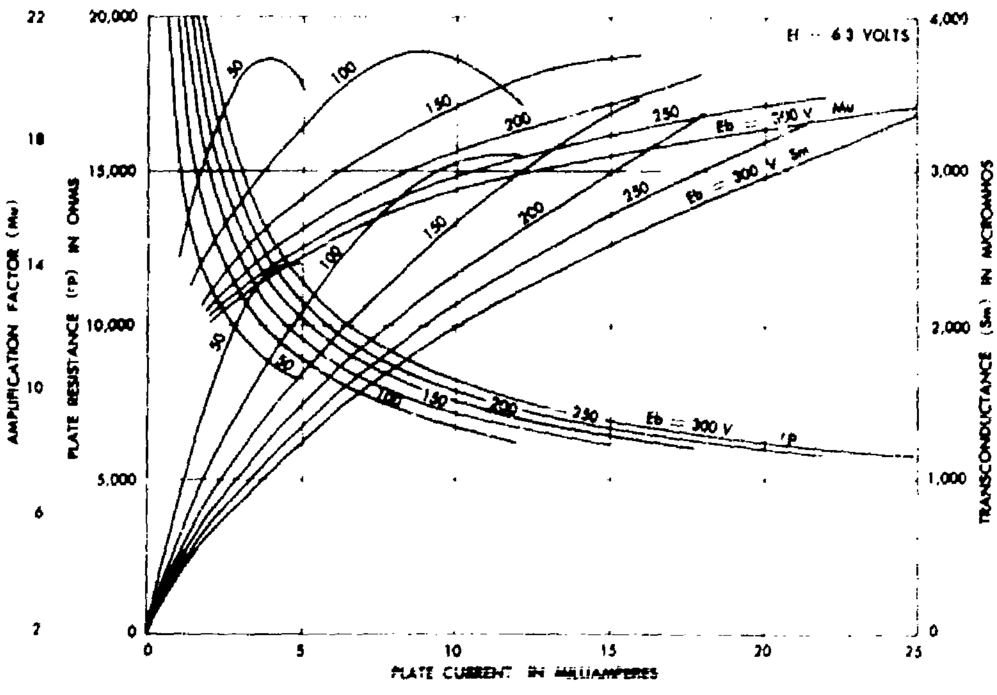


Figure 3-281. Typical JAN-5814A Characteristics; Sm, Mu and rp

SECTION 46

TUBE TYPE JAN-5829WA

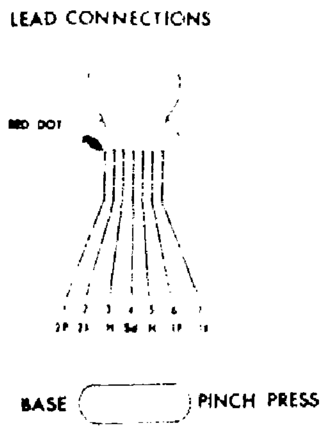
3.46. DESCRIPTION.

3.46.1 The JAN-5829WA 1/ is a 7-lead, pinch-press, subminiature, double diode.

3.46.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . . . mA 138 to 162
Cathode . . . . Coated Unipotential

3.46.3 MOUNTING. Not specified.



DIMENSIONS				
A MAX.	B		DIAMETER MAX.	
	DIM	TOL.	C MAX	D MAX
1.500	1.300	.100	.400	.285

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

*** WHEN SPECIFIED ON THE TSS

**** APPLIES TO PINCH PRESS TYPES ONLY (.02 MIN.)

† GROUND LEAD OVERLAPPED BY SHIELD BY A MINIMUM OF .04

†† SHIELD TO GROUND WIRE MAY BE FROM EITHER SIDE OF THE MAJOR DIMENSION. ALTERNATIVE CONSTRUCTION: UNUSED OR EXTRA RANDOM LEAD IN PRESS OR BUTTON MAY BE FOLDED BACK AND WRAPPED AROUND BULB TO MAKE CONTACT WITH SHIELD.

Figure 3-282. Outline Drawing and Base Diagram of Tube Type JAN-5829WA

1/ The values and specification comments presented in this section are related to MIL-E-1/292A dated 23 December 1955.

3.46.4 RATINGS, ABSOLUTE SYSTEM.

3.46.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.3 V
Plate Supply Voltage (per plate)	130 Vac
Peak Inverse Plate Voltage (per plate)	360 v
Heater-Cathode Voltage	360 v
Steadv State Peak Plate Current (per plate)	33 ma
Output Current (per plate)	5.5 mAdc
Transient Peak Plate Current (per plate)	175 ma
* Bulb Temperature	220°C
* Altitude Rating	60,000 ft

3.46.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.46.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Supply Voltage (per plate), Epp	117 Vac
Load Resistance (Unity Power Factor), RL	14,000 ohms
Load Capacitance, CL	8 uf
Heater Cathode Voltage	0 V

3.46.8 ACCEPTANCE TEST LIMITS.

3.46.9 Table 3-76 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/292A dated 23 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.46.10 APPLICATION.

3.46.11 SIGNAL RECTIFIER SERVICE. In the application of JAN-5829WA in signal rectifier service, Figure 3-283 relates boundaries of permissible operation and the questionable area of operation, to the plate characteristic. Permissible steady state peak plate current is limited to 33 milliamperes per plate, to define boundary (1), and d-c output current is limited to 5.5 milliamperes per plate to define boundary (2). Area (3) is defined as questionable from the standpoint of uniformity and stability of plate current in low-level signal rectifier applications. Although the specification enforces a control on plate current balance between the two sections to within 5 microamperes under MIL-E-1 test conditions, there is little assurance of such balance under conditions of heater operation differing from test conditions. Reference should be made to paragraphs 1.3.5 through 1.3.8 for a review of the behavior of initial electron velocity and contact potential in tubes in general, where the control grid currents discussed are equivalent to plate currents in signal diode application.

* No test at this rating exists in the Specification.

3.46.12 SUPPLY VOLTAGE RECTIFIER SERVICE. Rating Charts I, II, and III (Figures 3-284, 285 and 286) represent areas of permissible operation within which any application of the JAN-5829WA must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

TABLE 3-76. ACCEPTANCE TEST LIMITS OF JAN-5829WA

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		138	162	135	165	mA
Plate Current	Ib	Ebb=0; Rp = 40,000	2	20	---	---	uAdc
Difference between sections	△ Ib		---	5	---	---	uAdc
Operation	Io	See Note Below	9.0	---	7.0	---	mAdc
Emission	Is	Eb - 6.5 Vdc	15	---	---	---	mAdc
Capacitance (Without Shield)	Cp-p	Ef = 0	0.06	0.12	---	---	uuf
Cpl-h+kl+sd (except p2)	Cpl-all	Ef = 0	1.9	3.5	---	---	uuf
Cp2-h+k2+sd (except pl)	Cp2-all	Ef = 0	1.7	3.3	---	---	uuf
Ckl-h+pl+sd	Ckl-all	Ef = 0	2.4	4.2	---	---	uuf
Ck2-h+p2+sd	Ck2-all	Ef = 0	2.8	4.6	---	---	uuf
	Ckl-h	Ef = 0	1.1	2.2	---	---	uuf
	Ck2-h	Ef = 0	1.3	2.5	---	---	uuf
Heater-Cathode Leakage	Ihk	Ehk = +100 Vdc	---	10	0	20	uAdc
	Ihk	Ehk = -100 Vdc	---	-10	0	-20	uAdc
Insulation of Electrodes	R(p-all)	Ep-all = -300Vdc	100	---	50	---	Meg

Note: In a full wave circuit, adjust Zp (per plate) so that a tube having Etd = 5.5 Vdc at 15 mAdc (per plate) gives an Io = 10 mAdc. The minimum peak plate current shall be 25 ma.

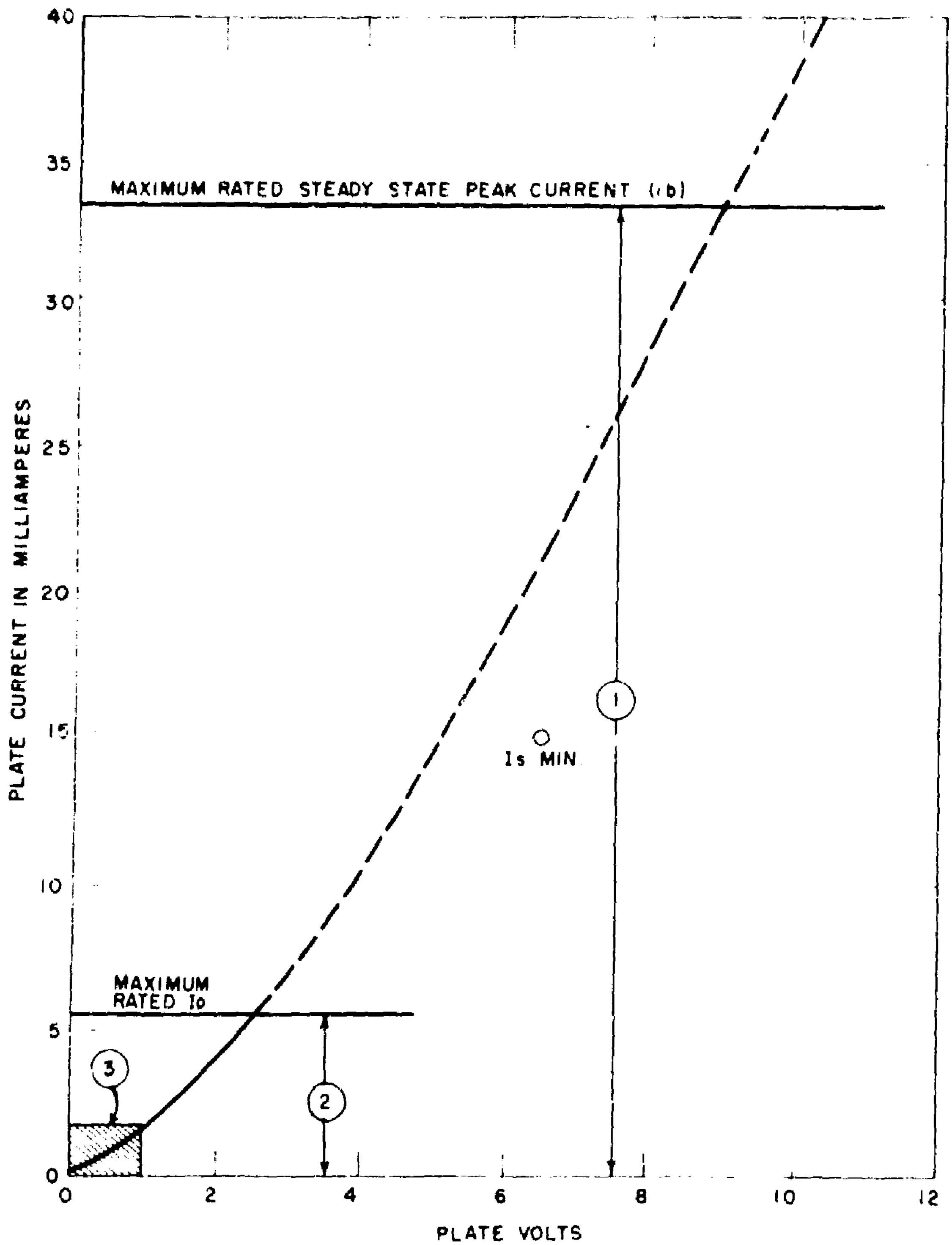


Figure 3-283. Permissible Limits of Operation for Tube Type JAN-5829WA

3.46.13 RATING CHART I. Rating Chart I (Figure 3-284) is based on maximum rated peak inverse voltage per plate (epx) of 360 volts and maximum rated d-c output current per plate (Io/p) of 5.5 milliamperes. Point C corresponds to the occurrence of these two ratings permissible under choke-input filter conditions. Point E is based on life test conditions. The area CDE is limited to choke-input filter application.

3.46.14 RATING CHART II. Rating Chart II (Figure 3-285), for capacitor-input filter applications is based on maximum rated d-c output current per plate (Io/p) and maximum rated steady state peak plate current (ib) of 33 milliamperes per plate. Rectification efficiency is equal to

$$\frac{Eo}{\sqrt{2}\ Epp/p}$$

and must not exceed 0.67 under conditions of maximum rated d-c output current.

3.46.15 RATING CHART III. Rating Chart III (Figure 3-286), for capacitor-input filter applications, is based on maximum rated surge current (i surge) of 175 milliamperes per plate. Minimum permissible series resistance (Rs) is approximately 900 ohms per plate under conditions of maximum permissible supply voltage per plate.

3.46.16 OTHER CONSIDERATIONS.

3.46.17 HEATER VOLTAGE. See paragraph 3.4.8 for a discussion of heater voltage considerations.

3.46.18 LOW ELECTRODE CURRENT. For a discussion of low-electrode-current considerations, see paragraph 3.4.7.

3.46.19 TYPICAL CHARACTERISTICS.

3.46.20 Figure 3-287 presents the static plate characteristics of JAN-5829WA, reproducted from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification which provides only a minimum limit on emission.

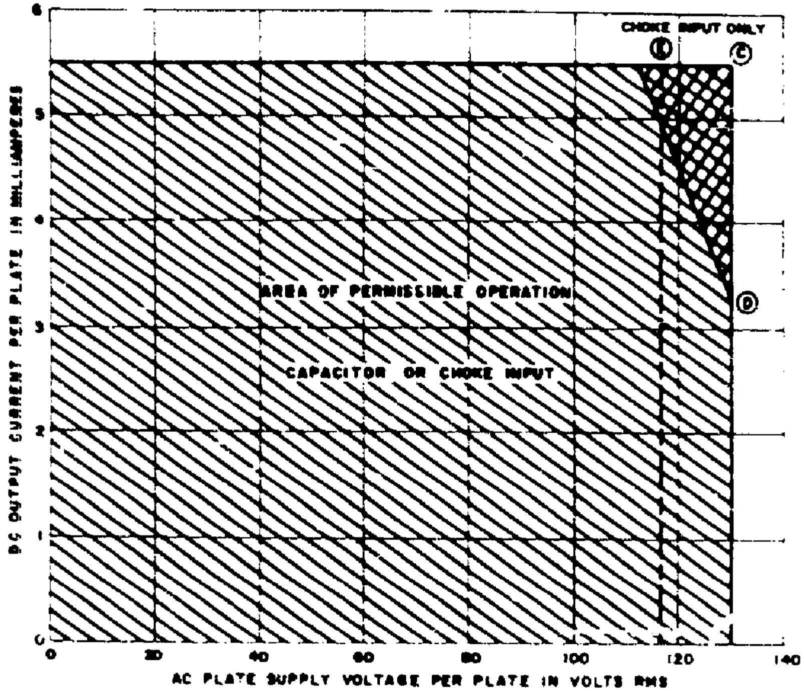


Figure 3-284. Rating Chart I for Tube Type JAN-5829WA Showing Permissible Operating Area for Choke and Capacitor Input Circuits

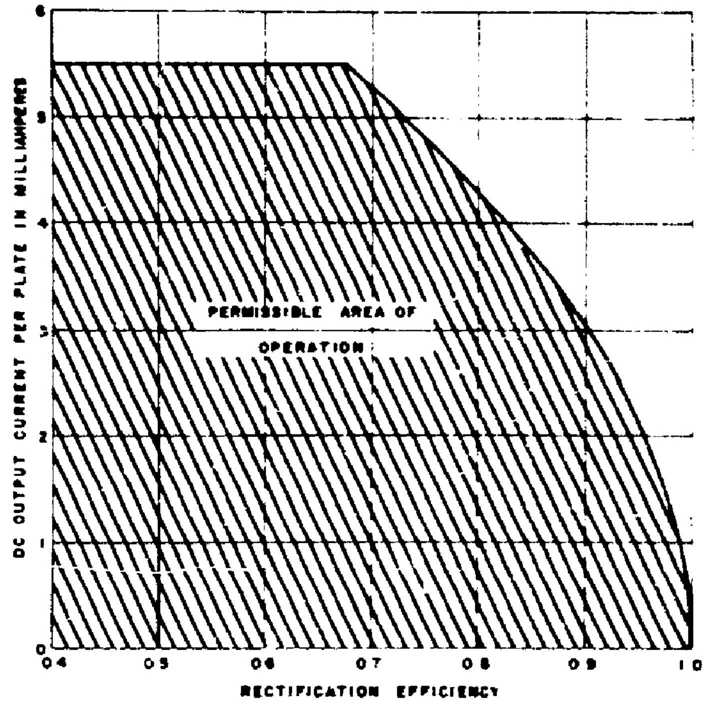


Figure 3-285. Rating Chart II for Tube Type JAN-5829WA Showing Permissible Operating Area for Capacitor Input Filter Operation

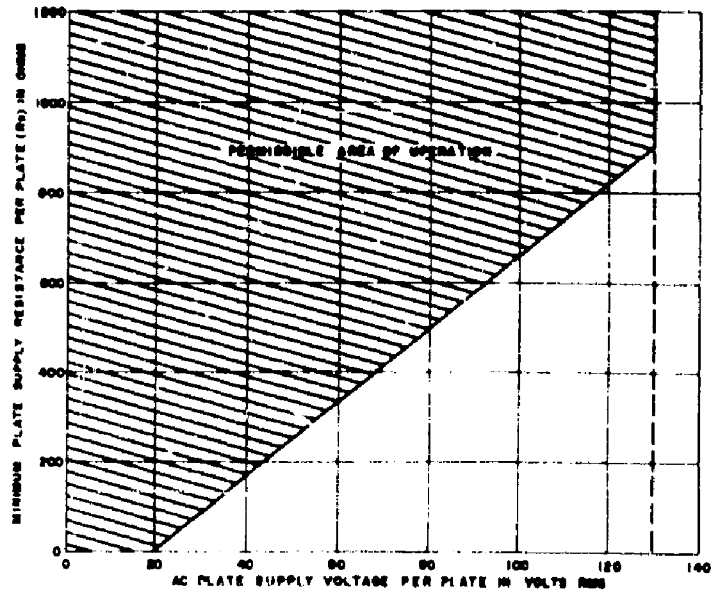


Figure 3-286. Rating Chart III for Tube Type JAN-5829WA Showing Minimum Allowable Resistance Effectively in Series with each Plate or Receiver Tube for an Allowable A-C Plate Voltage

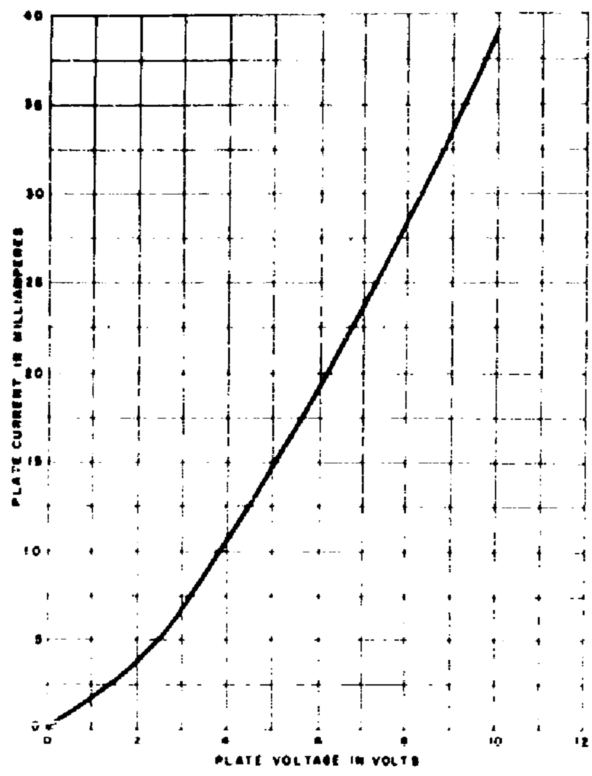


Figure 3-287. Typical Plate Characteristic of Tube Type JAN-5829WA

TUBE TYPE JAN-5840

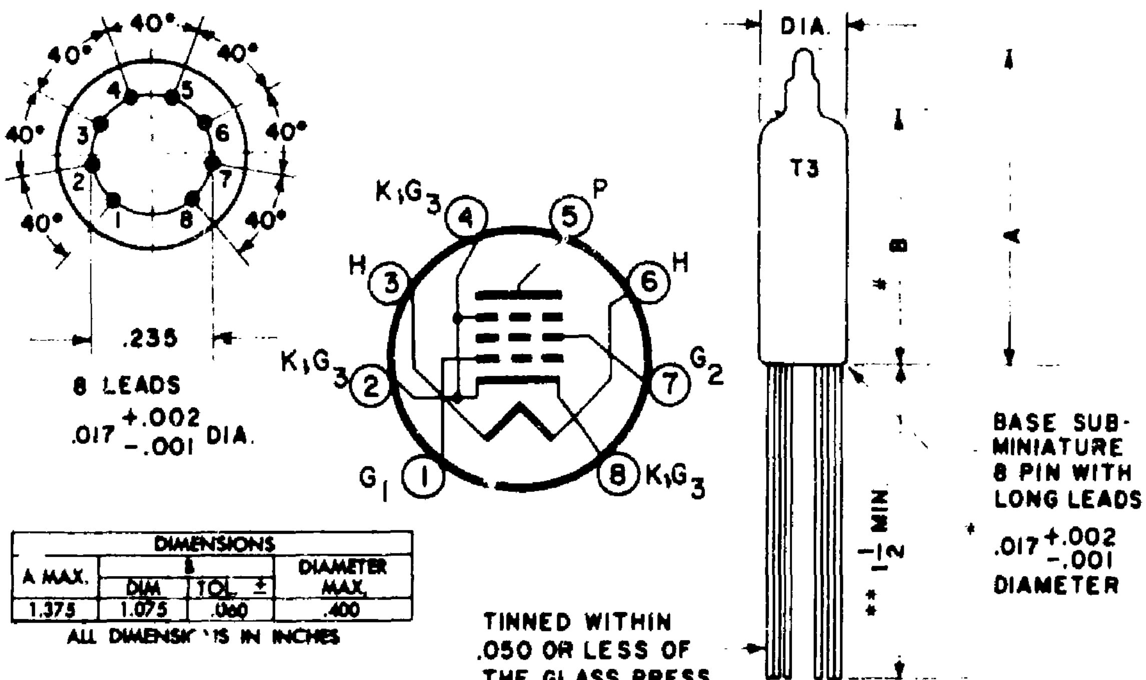
3.47 DESCRIPTION.

3.47.1 The JAN-5840 1/ is an 8-lead, button-base, subminiature, sharp-cutoff pentode having a design center transconductance of 5000 micromhos. The JAN-5840 is similar in plate characteristics to JAN-5702WA and the miniature type JAN-5654/6AK5W.

3.47.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 150 mA
Cathode . . . . Coated Unipotential

3.47.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B DIM	B TOL. ±	DIAMETER MAX.
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-288. Outline Drawing and Base Diagram of Tube Type JAN-5840

1/ The values and specification comments presented in this section are related to MIL-E-1/140B dated 25 August 1955.

3.47.4 RATINGS, ABSOLUTE SYSTEM.

3.47.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± .3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Control Grid Voltage, Maximum	0 Vdc
Control Grid Voltage, Minimum	-55 Vdc
* Screen Grid Voltage	155 Vdc
* Suppressor Grid Voltage	22 Vdc
Heater-Cathode Voltage	200 v
Control Grid Series Resistance	1.1 Meg
** Cathode Current, Maximum	16.5 mAdc
Plate Dissipation	0.80 W
Screen Grid Dissipation	0.35 W
Bulb Temperature	+220°C
Altitude Rating	60,000 ft

3.47.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.47.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Screen Grid Voltage, Ec 2	100 Vdc
Suppressor Grid Voltage, Ec3	0 Vdc
Cathode Resistance, Rk	150 ohms
Heater Current, If	150 mA
Plate Current, Ib	7.5 mAdc
Transconductance, Sm	5000 umhos

3.47.8 ACCEPTANCE TEST LIMITS.

3.47.9 Table 3-77 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/140B dated 25 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-77. ACCEPTANCE TEST LIMITS OF JAN-5840

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		140	160	138	164	mA
Transconductance (1)	Sm		4200	5800	---	---	umhos
Change in individuals	$\Delta \frac{Sm}{t}$		---	---	---	20	%
Plate Resistance	rp		0.175	---	---	---	Meg
Plate Current (1)	Ib		5.5	9.5	---	---	mAdc
Screen Grid Current	Ic2		1.5	3.3	---	---	mAdc
Capacitance	Cg1-p	Ef = 0	---	0.015	---	---	uuf
(Shielded as	Cin	Ef = 0	3.5	4.9	---	---	uuf
Specified)	Cout	Ef = 0	2.9	3.9	---	---	uuf
Control Grid Current	Ic1	Rg1= 1.0 Meg	0	-0.3	0	-0.8	uAdc
Heater-Cathode Leakage	Ihk	Ehk= +100 Vdc	---	5.0	---	10.0	uAdc
	Ihk	Ehk= -100 Vdc	---	-5.0	---	-10.0	uAdc
Insulation of Electrodes	R(g1-all)	Eg1-all= -100 Vdc	100	---	50	---	Meg
	R(p-all)	Ep-all = -300 Vdc	100	---	50	---	Meg

3.47.10 APPLICATION.

3.47.11 Figure 3-289 shows the permissible operating area for JAN-5840 as defined by the ratings in MIL-E-1/140B dated 25 August 1955. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.47.12 Table 3-78 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

3.47.13 VARIABILITY OF CHARACTERISTICS.

3.47.14 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3-47-15 Figure 3-290 presents the limit behavior of static plate characteristics for JAN-5840 as defined by MIL-E-1/140B dated 25 August 1955.

TABLE 3-78. APPLICATION PRECAUTIONS FOR JAN-5840

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
  High, 3.2.12
  Low, 3.2.3, 3.2.7
  28 Volt, 3.2.21
  AC Operation, 1.3.20, 3.2.18
Screen Grid:
  Supply, 3.2.8
  Protection, 3.2.22
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
  Cathode, 2.1.3, 3.2.15
  Fixed, 1.3.8, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.47.16 Figure 3-291 presents the limit behavior of static screen grid characteristics for JAN-5840.

3.47.17 Figure 3-292 presents the limit behavior of plate transfer data, for JAN-5840 as defined by MIL-E-1/140B dated 25 August 1955.

3.47.18 Figure 3-293 presents the limit behavior of screen grid transfer data for JAN-5840.

3.47.19 DESIGN CENTER CHARACTERISTICS.

3.47.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.47.21 Figure 3-294 presents the static plate characteristics of JAN-5840.

3.47.22 Figure 3-295 and 3-296 present the typical plate and screen transfer characteristics for JAN-5840, and Sm and Rp Characteristics.

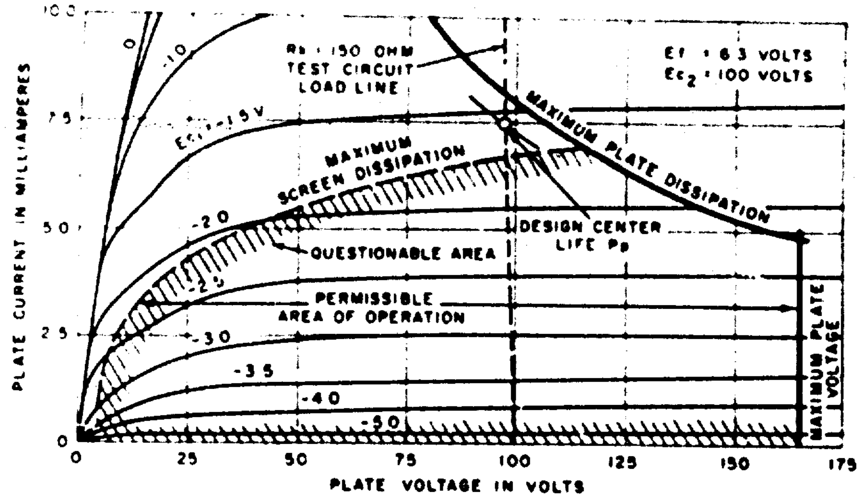


Figure 3-289. Typical Static Plate Characteristics of Tube Type JAN-5840; Permissible Area of Operation

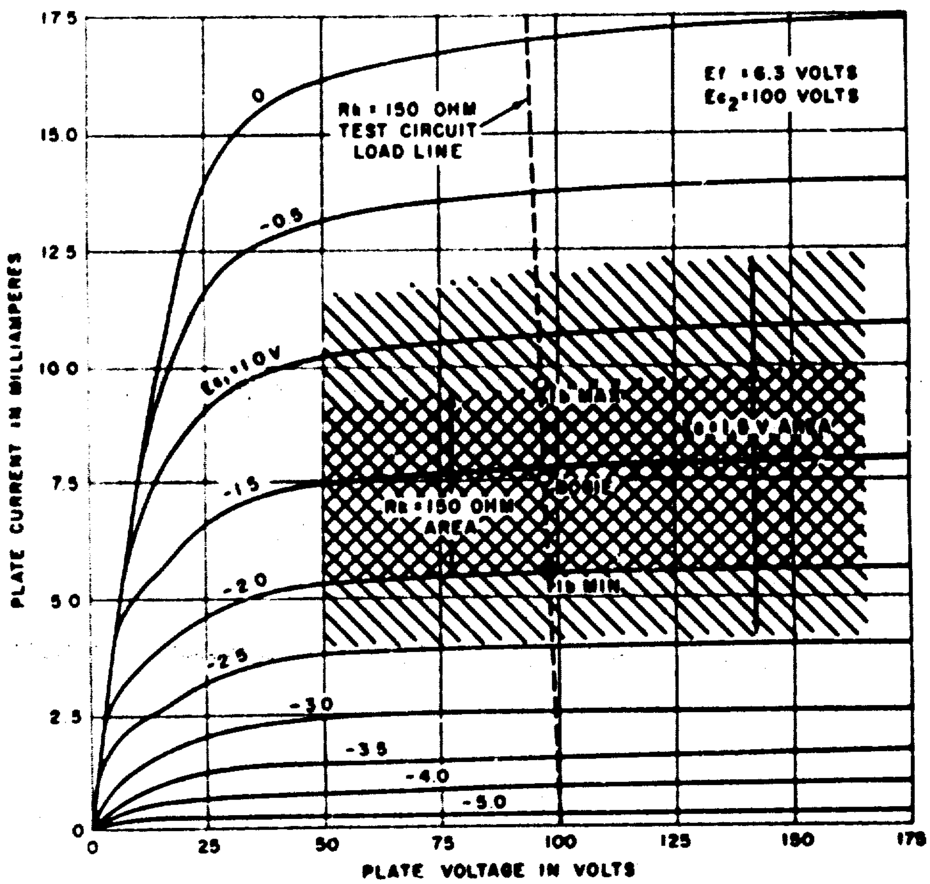


Figure 3-290. Limit Behavior of Tube Type JAN-5840, Static Plate Data; Variability of Ib

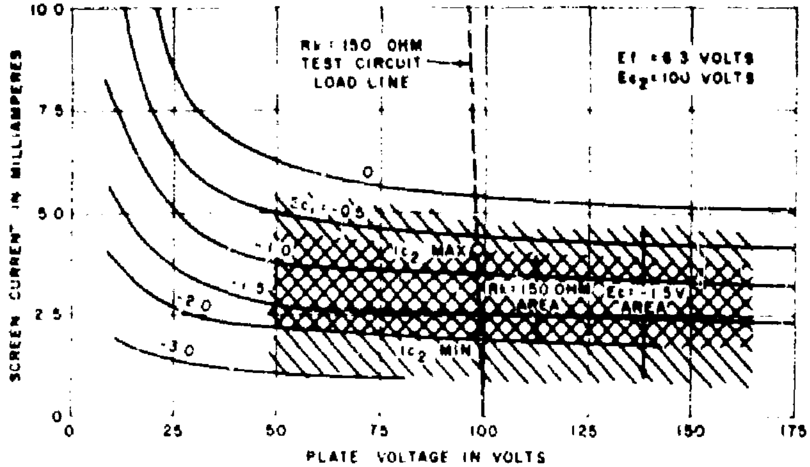


Figure 2-291. Limit Behavior of Tube Type JAN-5840 Static Plate Data; Variability of Ic2

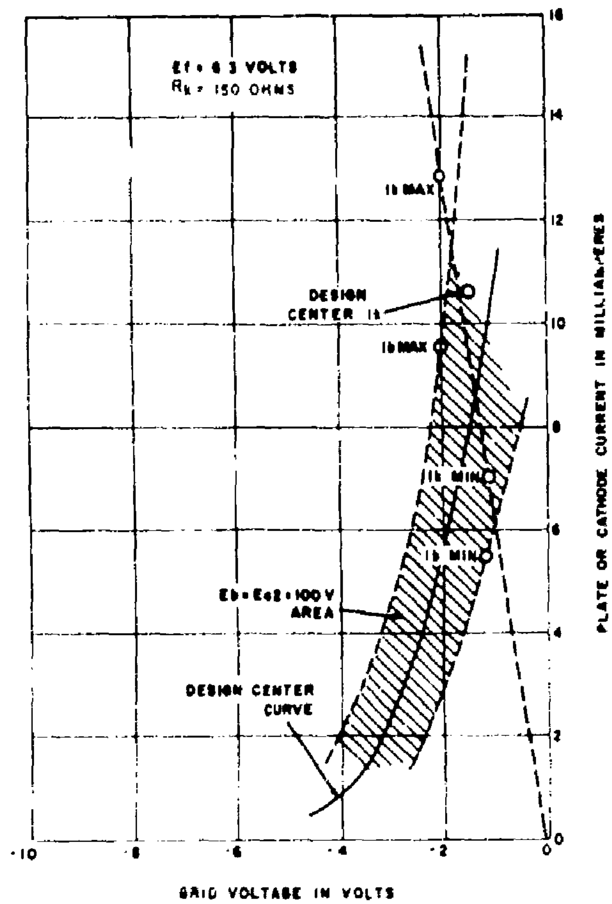


Figure 3-292. Limit Behavior of Tube Type JAN-5840 Transfer Data; Variability of Ib

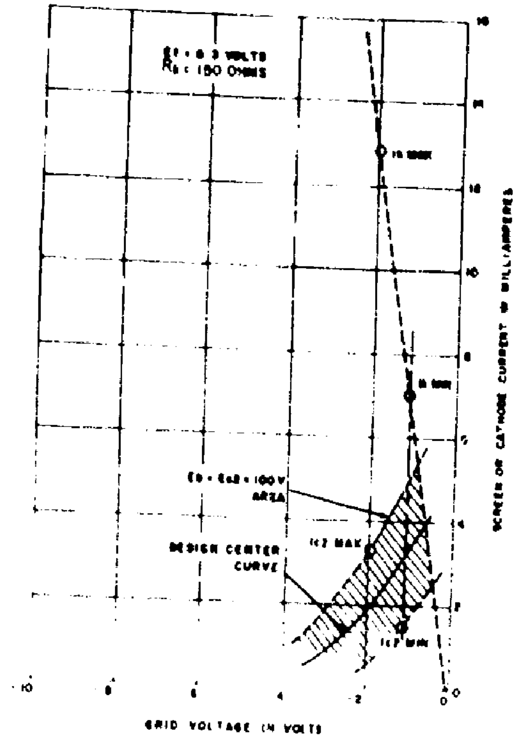


Figure 3-293. Limit Behavior of Tube Type JAN-5840 Transfer Data; Variability of Ic2

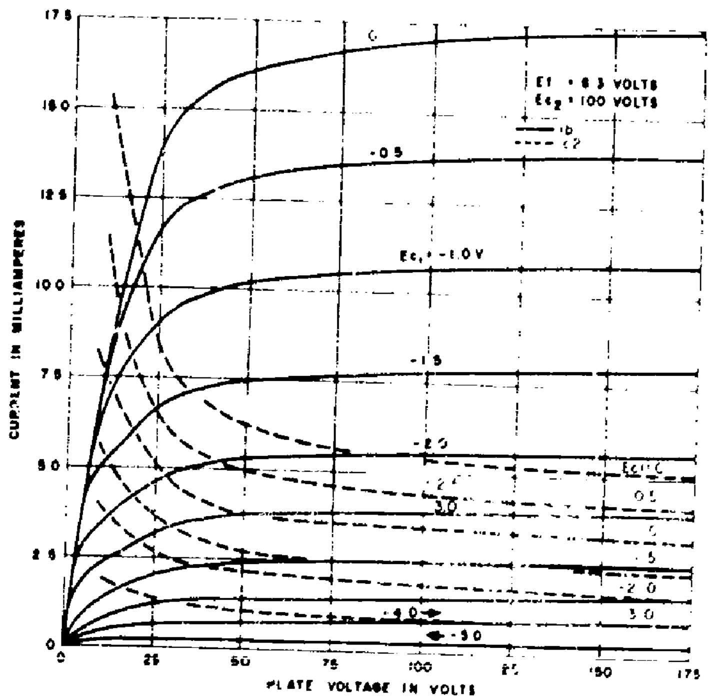


Figure 3-294. Typical Plate and Screen Characteristics of Tube Type JAN-5840

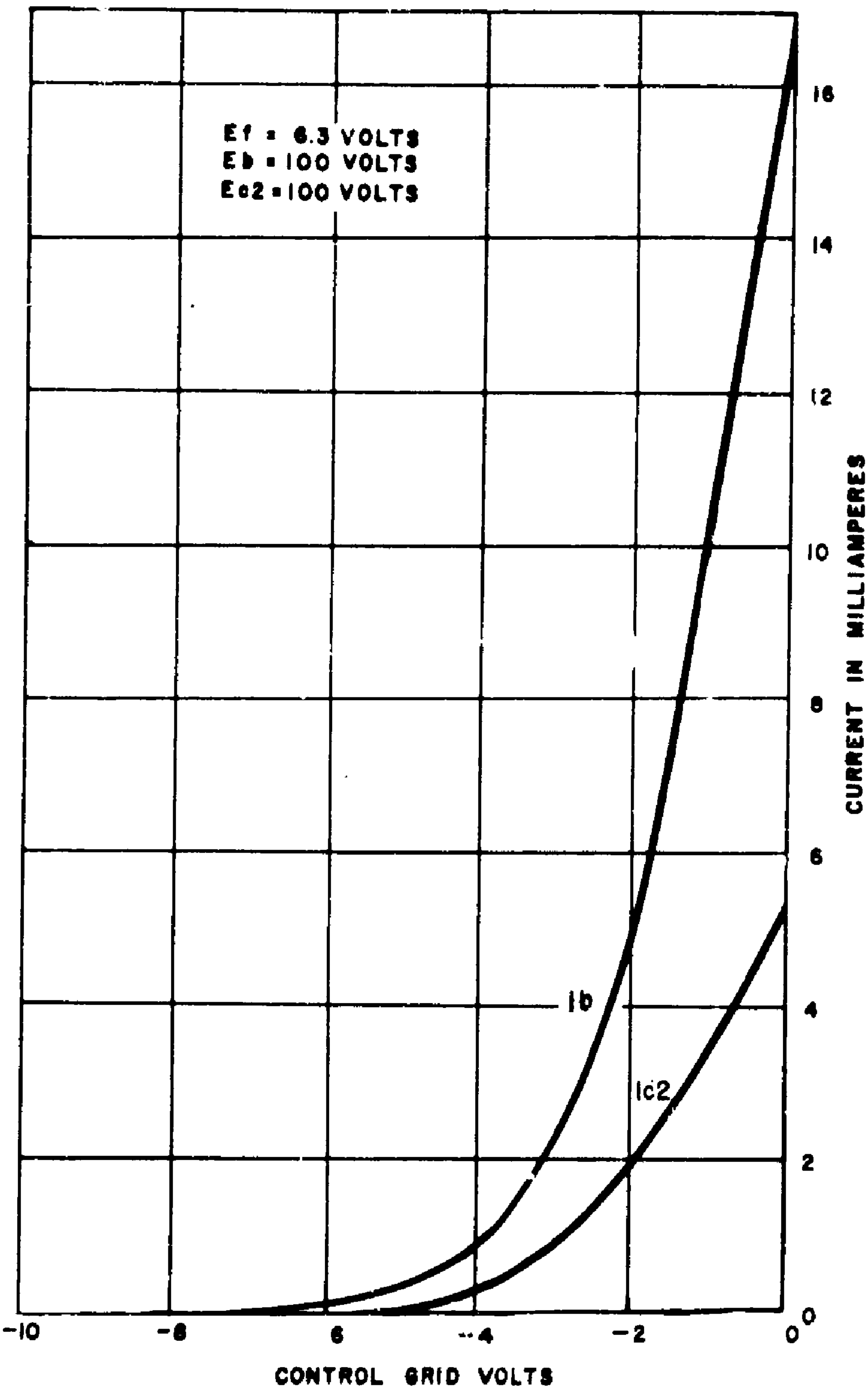
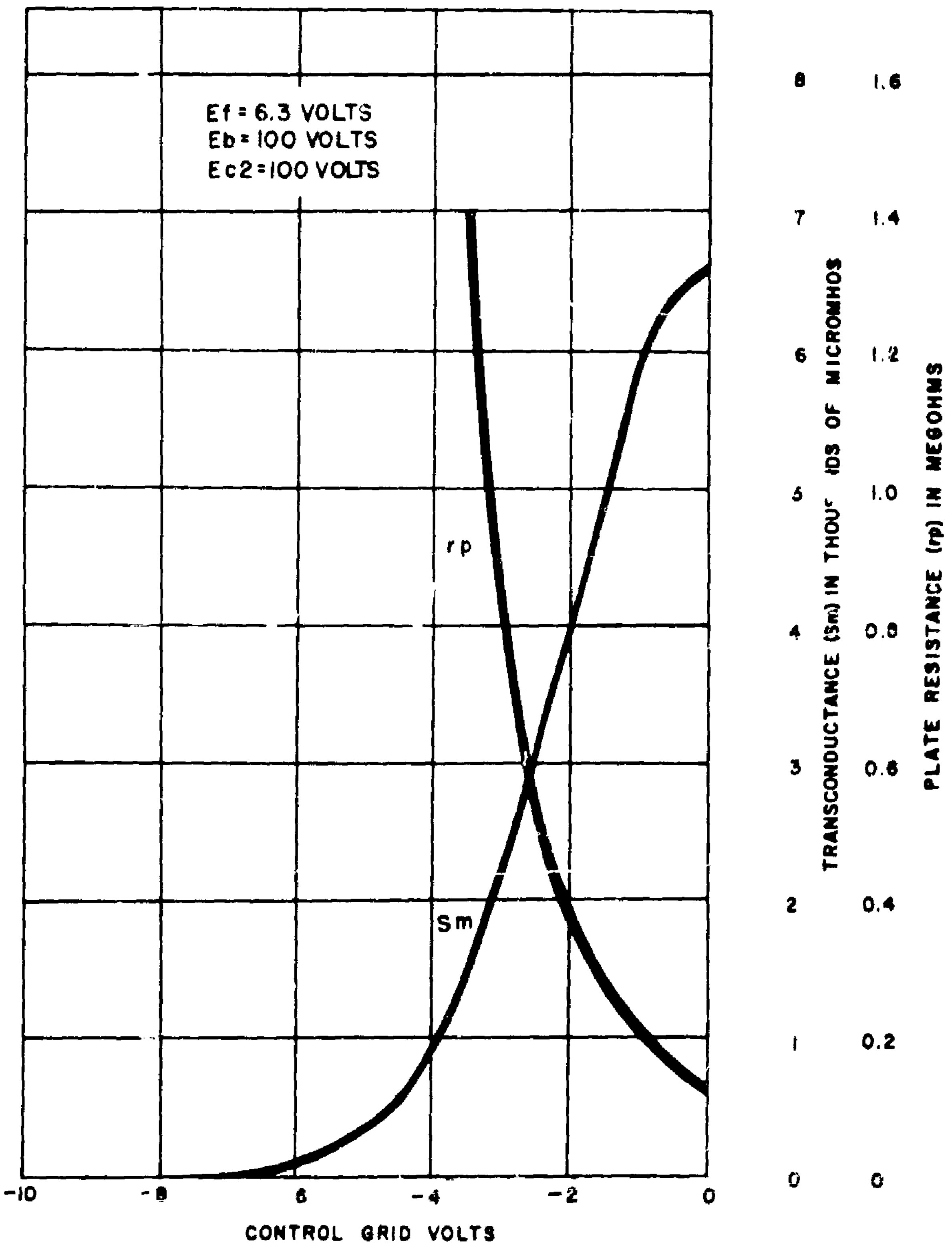


Figure 3-295. Typical Plate and Screen Transfer Characteristics for Tube Type JAN-584



"ype JAN-5840

Figure 3-296. Typical Sm and Rp Characteristics of Tube Type JAN-5840

SECTION 48

TUBE TYPE JAN-5896

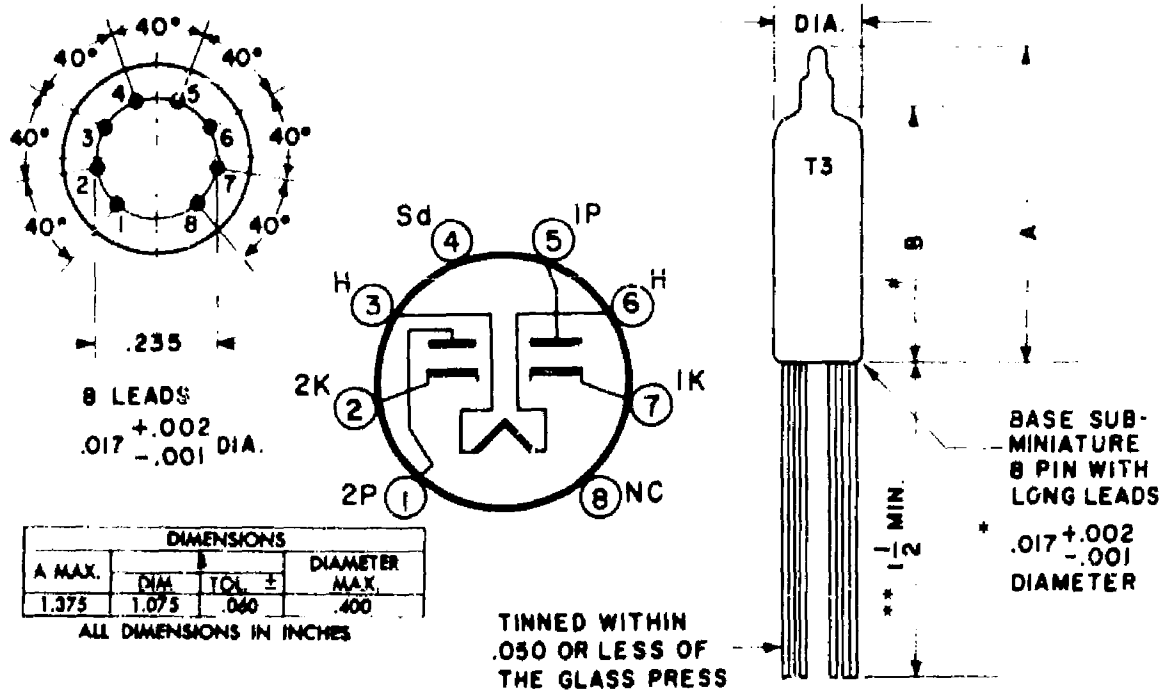
3.48 DESCRIPTION.

3.48.1 The JAN-5896 1/ is an 8-lead, button-base, subminiature, double diode.

3.48.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 300 mA
* Cathode . . . . Caoted Unipotential

3.48.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B DIM.	B TOL. ±	DIAMETER MAX.
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-297. Outline Drawing and Base Diagram of Tube Type JAN-5896

* Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

1/ The values and specification comments presented in this section are related to MIL-E-1/174C dated 23 June 1955.

3.48.4 RATINGS, ABSOLUTE SYSTEM.

3.48.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± .3 V
Peak Inverse Plate Voltage	460 v
Heater-Cathode Voltage	360 v
Steady State Peak Plate Current (per plate)	60 ma
Output Current (per plate)	10 mAdc
Transient Peak Plate Current (per plate)	350 ma
Bulb Temperature	+220°C
Altitude Rating	60,000 ft

3.48.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.48.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Supply Voltage (per plate), Epp	165 Vac
Load Resistance (Unity Power Factor) RL	11,000 ohms
Load Capacitance, CL	8 uf
Heater Current, If	300 mA

3.48.8 ACCEPTANCE TEST LIMITS.

3.48.9 Table 3-79 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/174C dated 23 June 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.48.10 APPLICATION

3.48.11 SIGNAL RECTIFIER SERVICE. In the application of JAN-5896 in signal rectifier service, Figure 3-298 relates boundaries of permissible operation and the questionable area of operation, to the plate characteristics. Permissible steady-state peak plate current is limited to 60 milliamperes per plate, to define boundary (1), and d-c output current is limited to 10 milliamperes per plate to define boundary (2). Area (3) is defined as questionable from the standpoint of uniformity and stability of plate current in low-level signal rectifer applications. Although the specification enforces a control on plate current balance between the two sections to within 5 microamperes under MIL-E-1 test conditions, there is little assurance of such balance under conditions of heater operation differing from test conditions. Reference should be made to section 1.3.4 for a review of the behavior of initial electron velocity and contact potential in tubes in general, where control grid currents discussed are equivalent to plate currents in signal diode application.

3.48.12 SUPPLY VOLTAGE RECTIFIER SERVICE. Rating Charts I, II and III (Figures 3-299 through 3-301) represent areas of permissible operation within

which any application of the JAN-5896 must fall. Requirements of all charts must be satisfied simultaneously in capacitor-input filter applications.

TABLE 3-79. ACCEPTANCE TEST LIMITS OF JAN-5896

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		280	320	276	328	mA
Operation	Io	See note below	16	---	---	---	mAdc
Change in Individual	Io		---	---	---	14	mAdc
Plate Current	Ib	Ebb = 0; Rp = 40,000 ohms	5.0	25	---	---	uAdc
Difference between sections	Ib		---	5.0	---	---	uAdc
Emission	Is	Eb = 10 Vdc	30	---	---	---	mAdc
Capacitance (Shielded as Specified)	C1p to 2p	Ef = 0	---	0.026	---	---	uuf
	C1p to h+1k +sd	Ef = 0	2.5	3.5	---	---	uuf
	C2p to h+2k+sd	Ef = 0	2.5	3.5	---	---	uuf
	C2k to h+2p+sd	Ef = 0	3.5	4.9	---	---	uuf
	C1k to h+1p+sd	Ef = 0	3.5	4.9	---	---	uuf
Heater-Cathode Leakage	Ihk	Ehk= +360 Vdc	---	40	---	80	uAdc
	Ihk	Ehk= -360 Vdc	---	-40	---	-80	uAdc
Insulation of Electrodes	R(p-all)	Ep-all= -500 Vdc	100	---	25	---	Meg

Note: In a full wave circuit, adjust Zp (per plate) so that a bogie tube gives Io = 18 mAdc. A bogie tube has a tube drop Etd = 10 Vdc at Is = 50 mAdc per plate. Ehk = Eo + 117 Vac.

3.48.13 RATING CHART I. Rating Chart I (Figure 3-299) is based on maximum rated peak inverse voltage per plate (epx) of 460 volts and maximum rated d-c output current per plate (Io/p) of 10 milliamperes. Point C corresponds to the simultaneous occurrence of these two ratings permissible under capacitor-or choke-input filter conditions.

3.48.14 RATING CHART II. Rating Chart II (Figure 3-300), for capacitor input filter applications, is based on maximum rated d-c output current per plate (Io/p) and maximum rated steady state peak plate current (ib/p) of 60 milliamperes per plate.

Rectification efficiency must not exceed 0.67 under conditions of maximum rated d-c output current.

3.48.15 RATING CHART III. Rating Chart III (Figure 3-301), for capacitor-input filter applications, is based on maximum rated surge current (i surge) of 350 milliamperes per plate. Minimum permissible series resistance (Rs) is approximately 560 ohms per plate under conditions of maximum permissible supply voltage per plate.

3.48.16 OTHER CONSIDERATIONS.

3.48.17 HEATER VOLTAGE. See paragraph 3.4.8 for a discussion of heater voltage considerations.

3.48.18 LOW ELECTRODE CURRENT. For a discussion of low-electrode current considerations, see paragraph 3.4.7.

3.48.19 TYPICAL CHARACTERISTICS.

3.48.20 Figure 3-302 presents the static plate characteristic of JAN-5896, reproduced from data published by the original RETMA registrant of the type. The extent of variation which may be exhibited among individual tubes cannot be derived from the specification which provides only a minimum limit on emission.

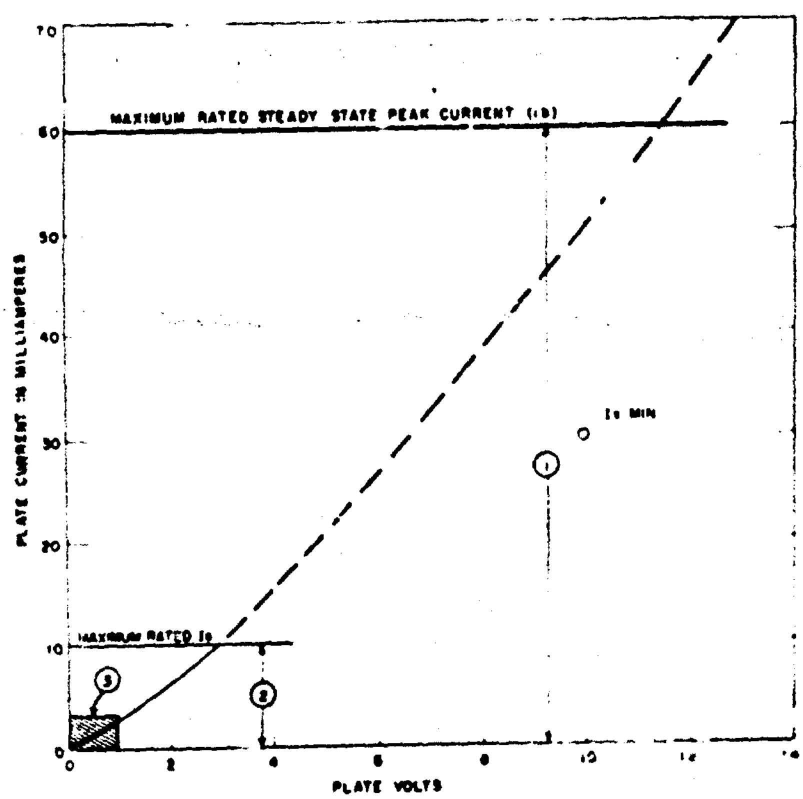


Figure 3-298. Permissible Limits of Operation for Tube Type JAN-5896

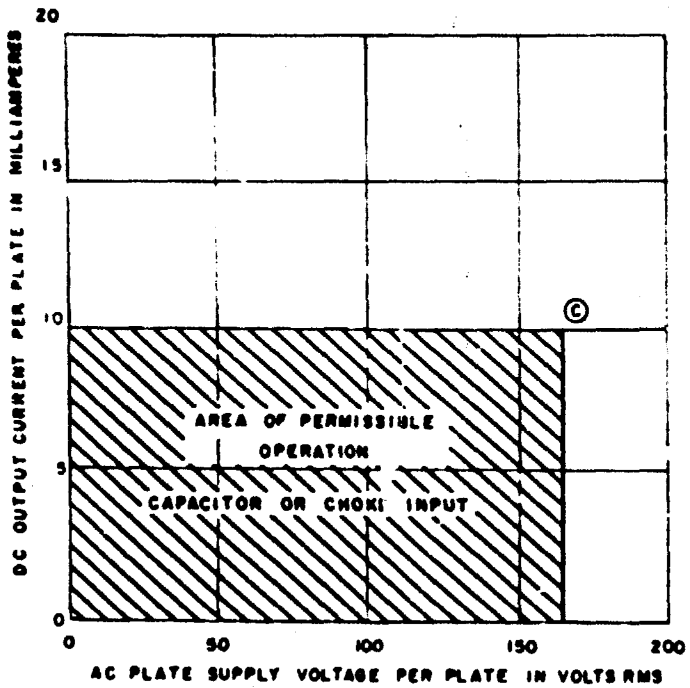


Figure 3-299. Rating Chart I for Tube Type JAN-5896 Showing Permissible Operating Area for Choke and Capacitor-Input Circuits

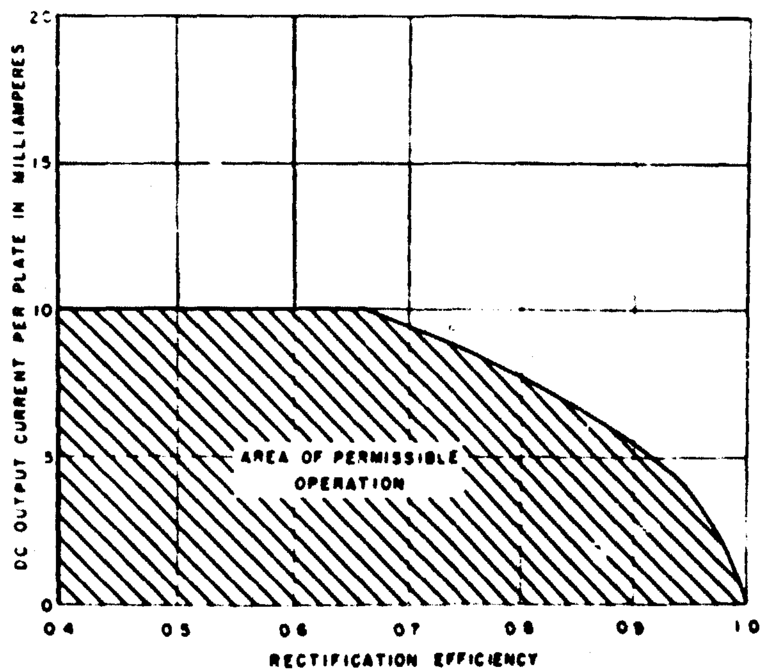


Figure 3-300. Rating Chart II for Tube Type JAN-5896 Showing Permissible Operating Area for Capacitor-Input Filter Operation

If Series Inductance is Present in the Plate Supply, Rs may be Less than shown Provided i Surge does not Exceed 350 mA.

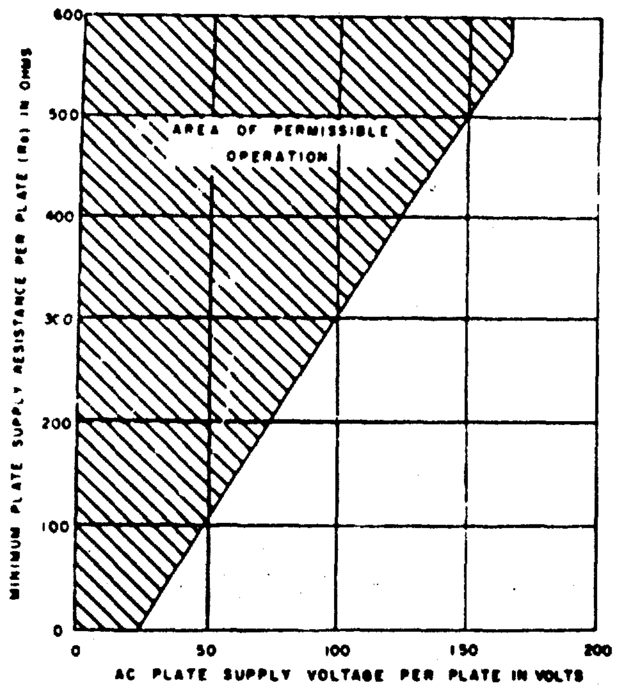


Figure 3-301. Rating Chart III for Tube Type JAN-5896 Showing Minimum Allowable Resistance Effectively in Series with each Plate or Receiver Tube for an Allowable A-C Plate Voltage

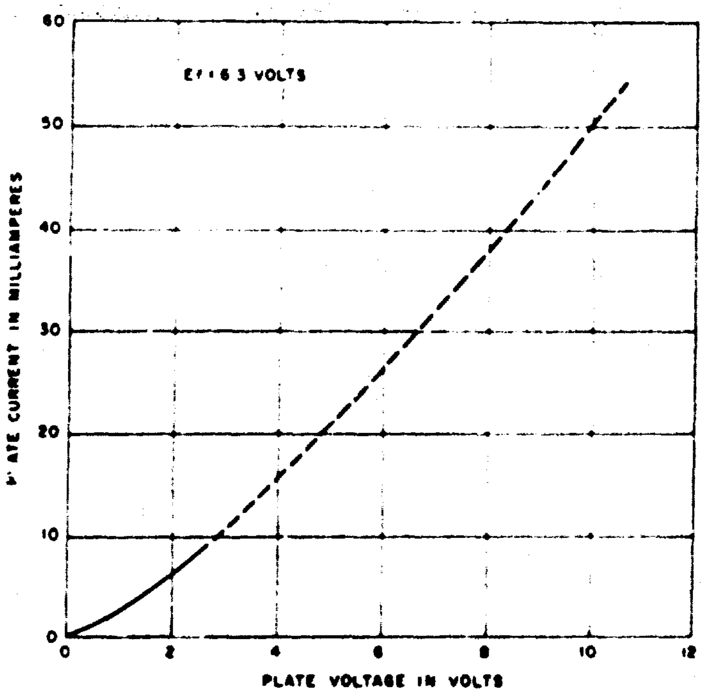


Figure 3-302. Typical Plate Characteristic Single Section for Tube Type JAN-5896

TUBE TYPE JAN-5899

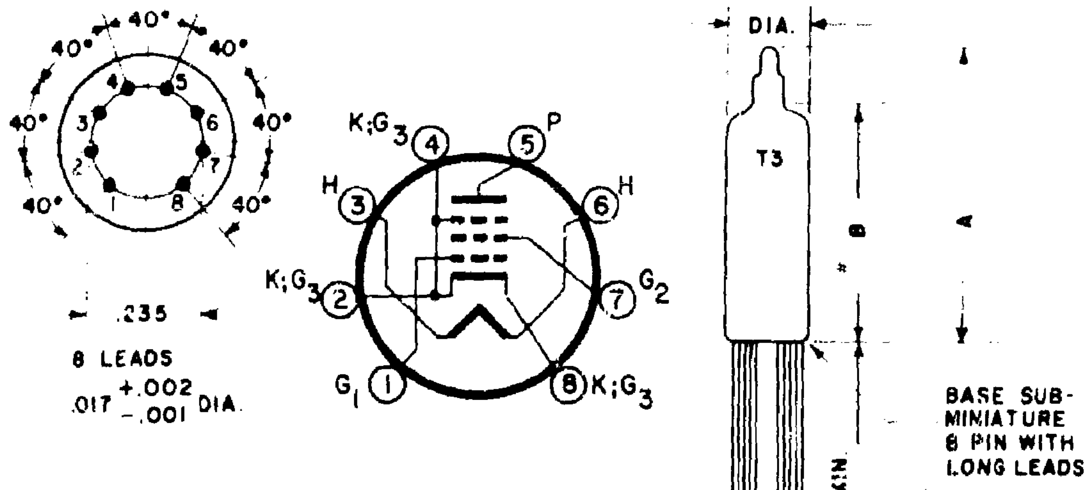
3.49 DESCRIPTION.

3.49.1 The JAN-5899 1/ is an 8-lead, button-base, subminiature, semi-remote cutoff pentode having a design center transconductance of 4500 micromhos.

3.49.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	6.3 V
Heater Current, Design Center	150 mA
Cathode	Coated Unipotential

3.49.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B DIM	B TOL. ±	DIAMETER MAX.
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-303. Outline Drawing and Base Diagram of Tube Type JAN-5899

1/ The values and specification comments presented in this section are related to MIL-E-1/97C dated 23 June 1955.

3.49.4 RATINGS, ABSOLUTE SYSTEM.

3.49.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± .3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1, Plate Voltage	
Control Grid Voltage, Maximum	0 Vdc
Control Grid Voltage, Minimum	-55 Vdc
*Screen Grid Voltage	155 Vdc
*Suppressor Grid Voltage	22 Vdc
Heater-Cathode Voltage	200 v
Control Grid Series Resistance	1.1 Meg
**Cathode Current, Maximum	16.5 mAdc
Plate Dissipation	0.75 W
*Screen Grid Dissipation	0.35 W
Bulb Temperature	220° C
Altitude Rating	60,000 ft

3.49.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.49.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Screen Grid Voltage, Ec2	100 Vdc
Suppressor Grid Voltage, Ec3	0 Vdc
Heater-Cathode Voltage	0 Vdc
Cathode Resistance, Rk	120 ohms
Heater Current, If	150 mA
Plate Current, Ib	7.2 mAdc
Transconductance, Sm	4500 umhos
Transconductance, Sm (Ec1= -14 Vdc, Rk=0)	25 umhos

3.49.8 ACCEPTANCE TEST LIMITS.

3.49.9 Table 3-80 summarizes certain salient measurements-data requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/97C dated 23 June 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-80. ACCEPTANCE TEST LIMITS OF JAN-5899

PROPERTY	MEASUREMENTS CONDITIONS	LIMITS				UNITS
		INITIAL		LIFE TEST		
		MIN	MAX	MIN	MAX	
Heater Current If		140	160	138	164	mA
Transconductance (1) Sm		3800	5200	---	---	umhos
Change in individuals Δ Sm t		---	---	---	20	%
Transconductance (2) Δ Sm Ef		---	10	---	15	%
Transconductance (3) Sm	Ec1 = -14 Vdc; Rk = 0	1.0	75	---	---	umhos
Plate Resistance rp		0.175	---	---	---	Meg
Plate Current (1) Ib		5.2	9.2	---	---	mAdc
Screen Grid Current Ic2		1.0	3.0	---	---	mAdc
Capacitance Cg1-p	Ef = 0	---	0.015	---	---	uuf
(Shielded as Cin	Ef = 0	3.8	4.8	---	---	uuf
Specified) Cout	Ef = 0	2.9	3.9	---	---	uuf
Control Grid Current Ic1	Rg1 = 1.0 Meg	0	-0.3	0	-0.8	uAdc
Heater-Cathode Ihk	Ehk = +100 Vdc	---	5.0	---	10	uAdc
Leakage Ihk	Ehk = -100 Vdc	---	-5.0	---	-10	uAdc
Insulation of R(g-all)	Eg1-all = -100Vdc	100	---	50	---	Meg
Electrodes R(p-all)	Ep-all = -300Vdc	100	---	50	---	Meg

3.49.10 APPLICATION.

3.49.11 Figure 3-304 shows the permissible operating area for JAN-5899 as defined by the ratings in MIL-E-1/97C dated 23 June 1955. A disucssion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.49.12 Table 3-81 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

3.49.13 VARIABILITY OF CHARACTERISTICS.

3.49.14 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.49.15 Figure 3-305 presents the limit behavior of static plate characteristics for JAN-5899 as defined by MIL-E-1/97C dated 23 June 1955.

3.49.16 Figure 3-306 presents the limit behavior of plate transfer data for JAN-5899 as defined by MIL-E-1/97C dated 23 June 1955.

3.49.17 DESIGN CENTER CHARACTERISTICS.

3.49.18 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.49.19 Figure 3-307 presents the static plate characteristics of JAN-5899.

3.49.20 Figures 3-308 and 3-309 present the typical plate transfer data for JAN-5899.

TABLE 3-81. APPLICATION PRECAUTIONS FOR JAN-5899

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27
1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation, 1.3.20, 3.2.18
Screen Grid:
Supply, 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Fixed, 1.3.8, 2.1.3, 3.2.15
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.3, 1.3.19,
1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.34,
2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23,
3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

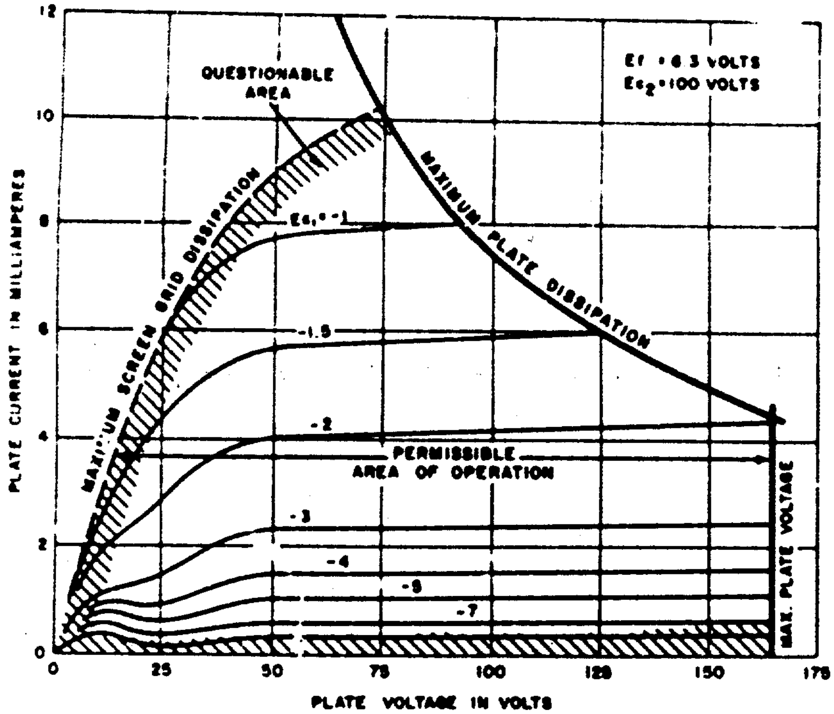


Figure 3-304. **Typical Static Plate Characteristics of Tube Type JAN-5899; Permissible Area of Operation**

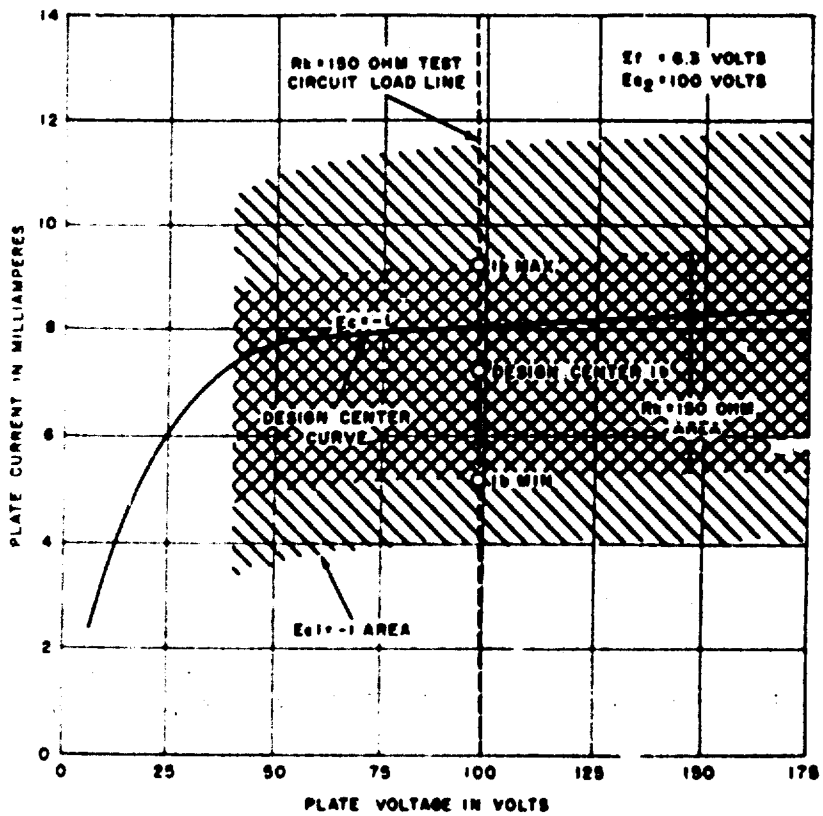


Figure 3-305. **Limit Behavior of Tube Type JAN-5899; Static Plate Data, Variability of Ib**

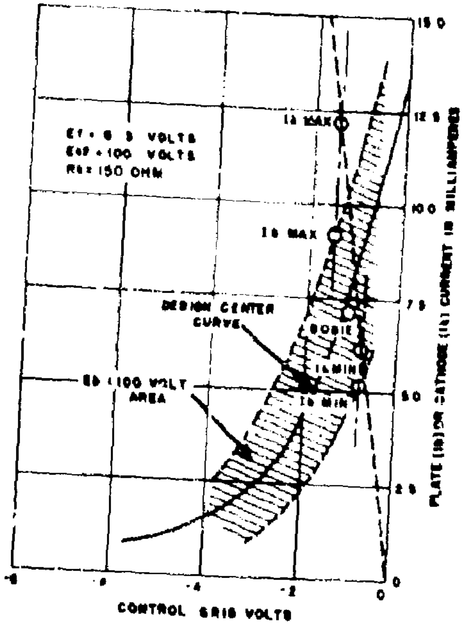


Figure 3-306. Limit Transfer Data for Tube Type JAN-5899; Variability of Ib

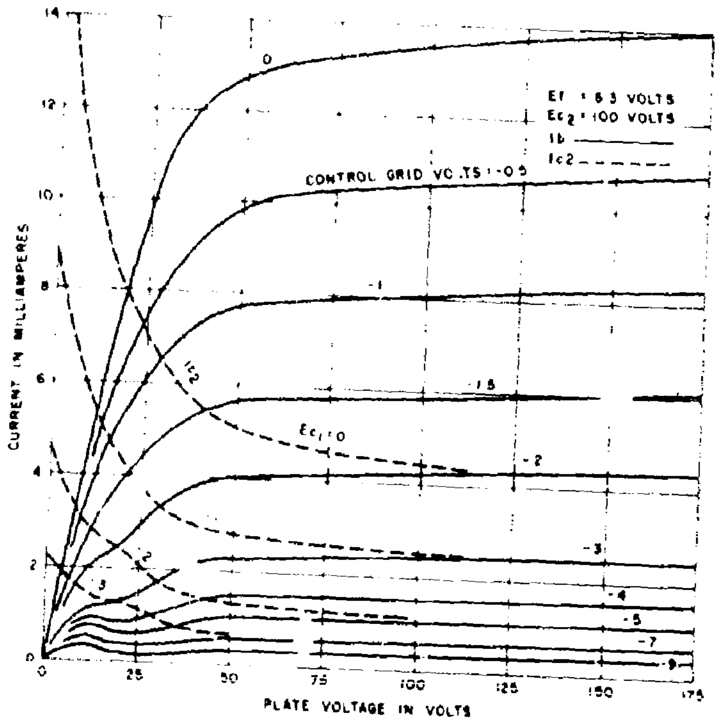


Figure 3-307. Typical Plate Characteristics for Tube Type JAN-5899

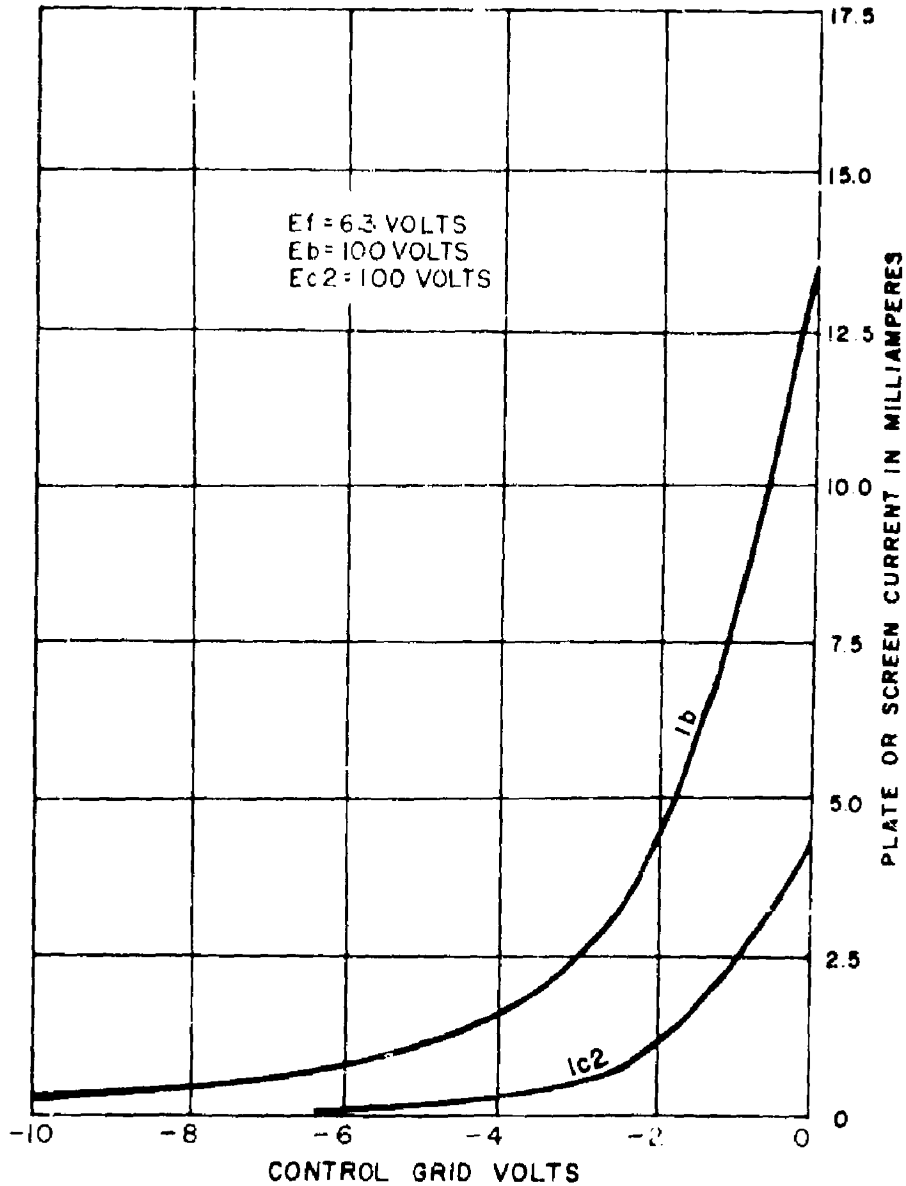


Figure 3-308. Typical Plate and Screen Transfer Characteristics of Tube Type JAN-5899

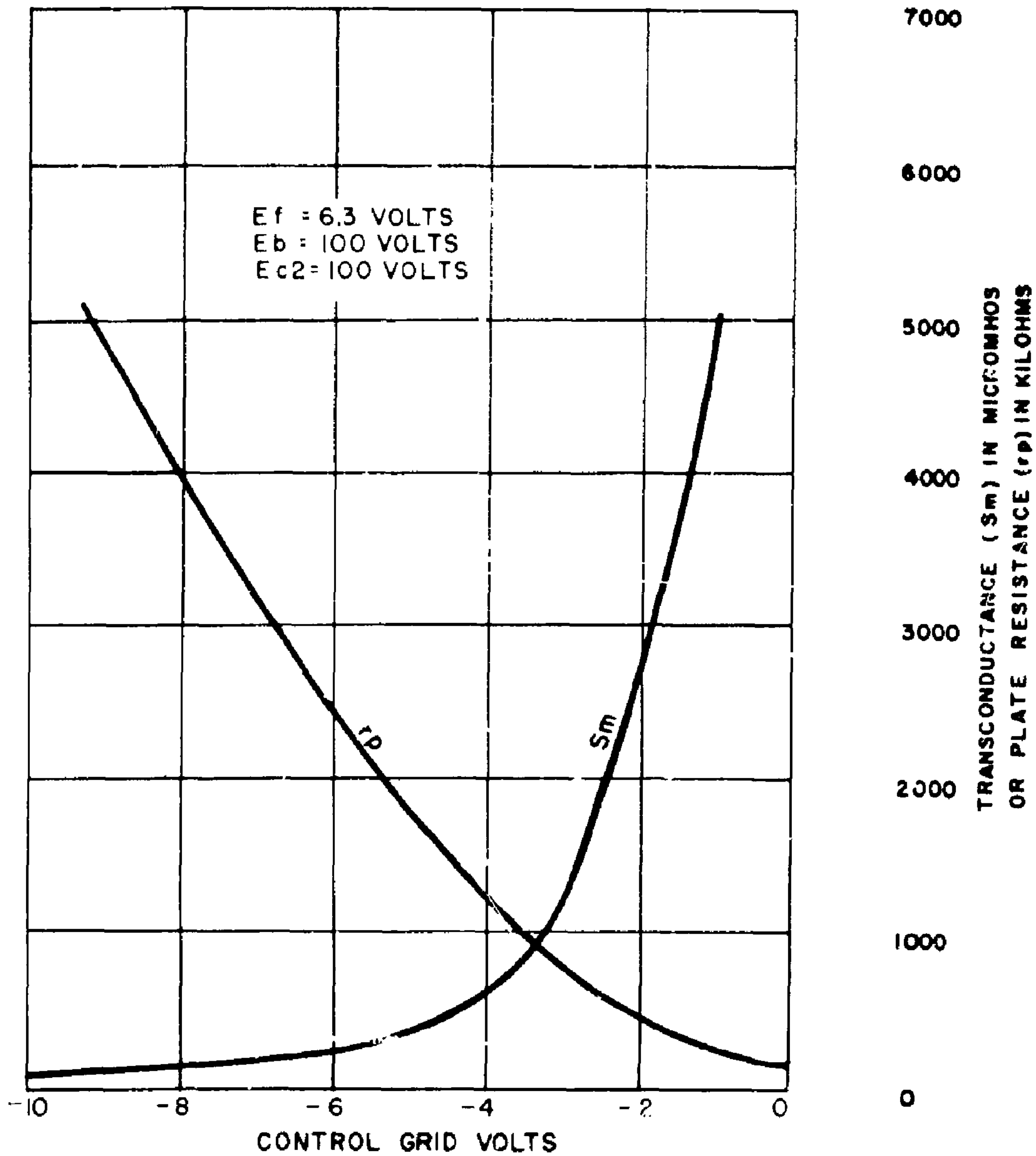


Figure 3-309. Typical Sm and Rp Characteristic of Tube Type JAN-5899

SECTION 50

TUBE TYPE JAN-5902

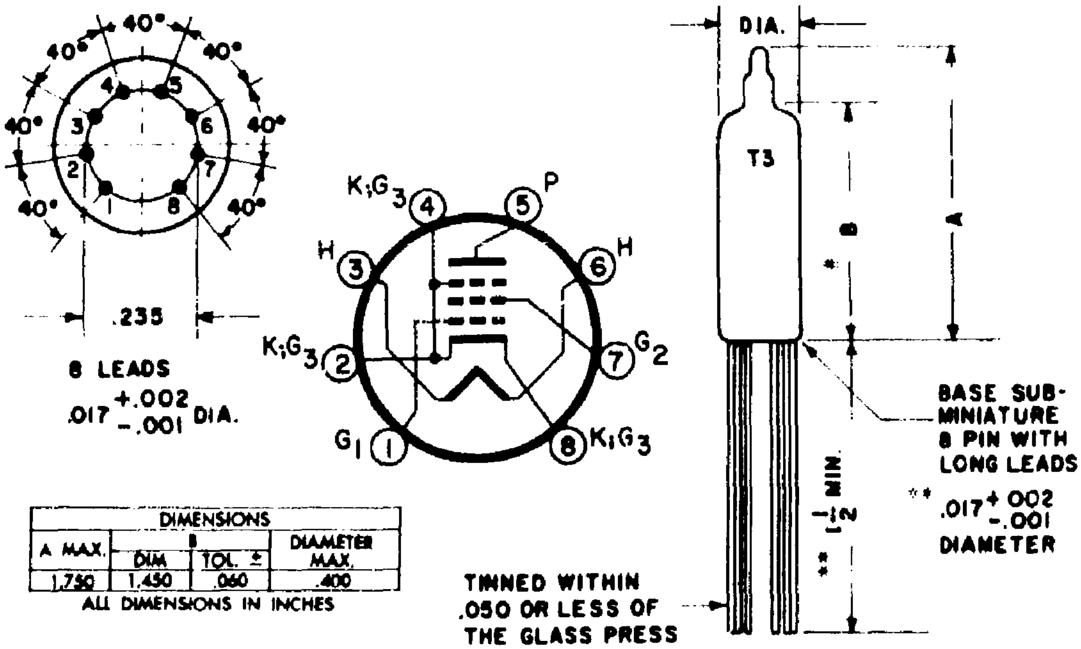
3.50 DESCRIPTION.

3.50.1 The JAN-5902 1/ is an 8-lead, button-base, subminiature, beam-power pentode having a design center transconductance of 4200 micromhos.

3.50.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 450 mA
Cathode . . . . Coated Unipotential

3.50.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX.
	DIM	TOL. ±	
1.750	1.450	.060	.400

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-310. Outline Drawing and Base Diagram of Tube Type JAN-5902

1/ The values and specification comments presented in this section are related to MIL-E-1/175B dated 26 October 1954.

3.50.4 RATINGS, ABSOLUTE SYSTEM.

3.50.5 The absolute system ratings are as follows:

Heater Voltage. . . . . .6.3 ± 0.3 V
Plate Voltage . . . . .165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Control Grid Voltage, Maximum . . . . 0 Vdc
Control Grid Voltage, Minimum . . . .-55 Vdc
* Screen Grid Voltage . . . . .155 Vdc
Heater-Cathode Voltage. . . . . 200 v
Control Grid Series Resistance . . . . 0.55 Meg
** Cathode Current, Maximum . . . . 50 mAdc
Plate Dissipation . . . . 3.7 W
Screen Grid Dissipation . . . . 0.4 W
Bulb Temperature . . . . +200°C
Altitude Rating. . . . . 60,000 ft

3.50.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.50.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef . . . . 6.3 V
Plate Voltage, Eb . . . . .110 Vdc
Screen Grid Voltage, Ec2 . . . . .110 Vdc
Cathode Resistance, Rk . . . . .270 ohms
Heater Current, If . . . . 450 mA
Plate Current, Ib . . . . 30.0 mAdc
Transconductance, Sm . . . . 4200 umhos

3.50.8 ACCEPTANCE TEST LIMITS.

3.50.9 Table 3-82 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/175B dated 26 October 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.50.10 APPLICATION.

3.50.11 Figure 3-311 shows the permissible operating area for JAN-5902 as defined by the ratings in MIL-E-1/175B dated 26 October 1954. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

---

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-82. ACCEPTANCE TEST LIMITS OF JAN-5902

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		420	480	414	492	mA
Transconductance (1)	Sm		3500	4900	---	---	umhos
Plate Resistance	rp		0.01	---	---	---	Meg
Plate Current (1)	Ib		23.0	37.0	---	---	mAdc
Screen Grid Current	Ic2		0	4.0	---	---	mAdc
Power Output	Po	Esig= 6.4 Vac Rp = 3000	0.75	---	---	---	W
Change in individuals	Δ_tPo	Esig= 6.4 Vac Rp = 3000	---	---	---	20	%
Capacitance	Cgp	Ef = 0	---	0.20	---	---	uuf
(Shielded as	Cin	Ef = 0	5.5	7.5	---	---	uuf
Specified)	Cout	Ef = 0	6.5	8.5	---	---	uuf
Control Grid Current	Ic1	Rg = 1.0 Meg	0	-1.0	0	-2.0	uAdc
Heater-Cathode Leakage							
	Ihk	Ehk= +100 Vdc	---	15	---	60	uAdc
	Ihk	Ehk= -100 Vdc	---	-15	---	-60	uAdc
Insulation of Electrodes							
	R(g1-all)	Eg1-all= -100 Vdc	50	---	25	---	Meg
	R(p-all)	Ep-all = -300 Vdc	50	---	25	--	Meg

3.50.12 Table 3-83 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

3.50.13 SPECIAL OPERATING CONSIDERATIONS. An initial Class A power output requirement of 0.75 watts is imposed by the current specification, with an allowable change on life of 20% for individual tubes..

3.50.14 VARIABILITY OF CHARACTERISTICS.

3.50.15 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

TABLE 3-83. APPLICATION PRECAUTIONS FOR JAN-5902

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation, 1.3.20, 3.2.18
Screen Grid:
Supply, 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Fixed, 1.3.8, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode Thermionic instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode, Connection 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

3.50.16 Figure 3-312 presents the limit behavior of static plate characteristics for JAN-5902 as defined by MIL-E-1/175B dated 26 October 1954.

3.50.17 Figure 3-313 presents the limit behavior of transfer data for JAN-5902 as defined by MIL-E-1/175B dated 26 October 1954.

3.50.18 DESIGN CENTER CHARACTERISTICS.

3.50.19 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.50.20 Figure 3-314 presents the static plate characteristics of JAN-5902.

3.50.21 Figures 3-315 and 3-316 present the typical plate transfer data for JAN-5902.

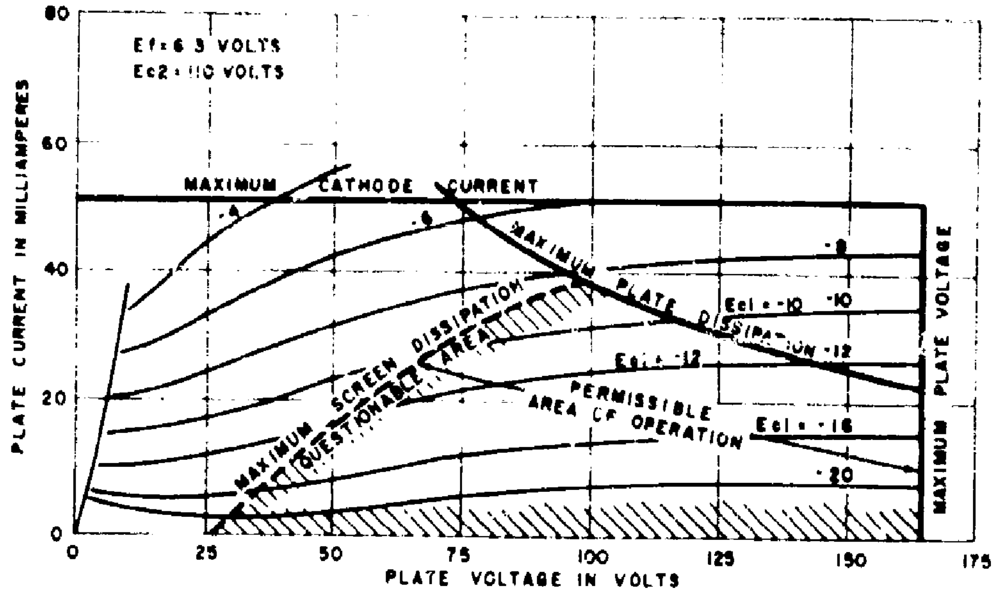


Figure 3-311. Typical Static Plate Characteristics of Tube Type JAN-5902; Permissible Area of Operation

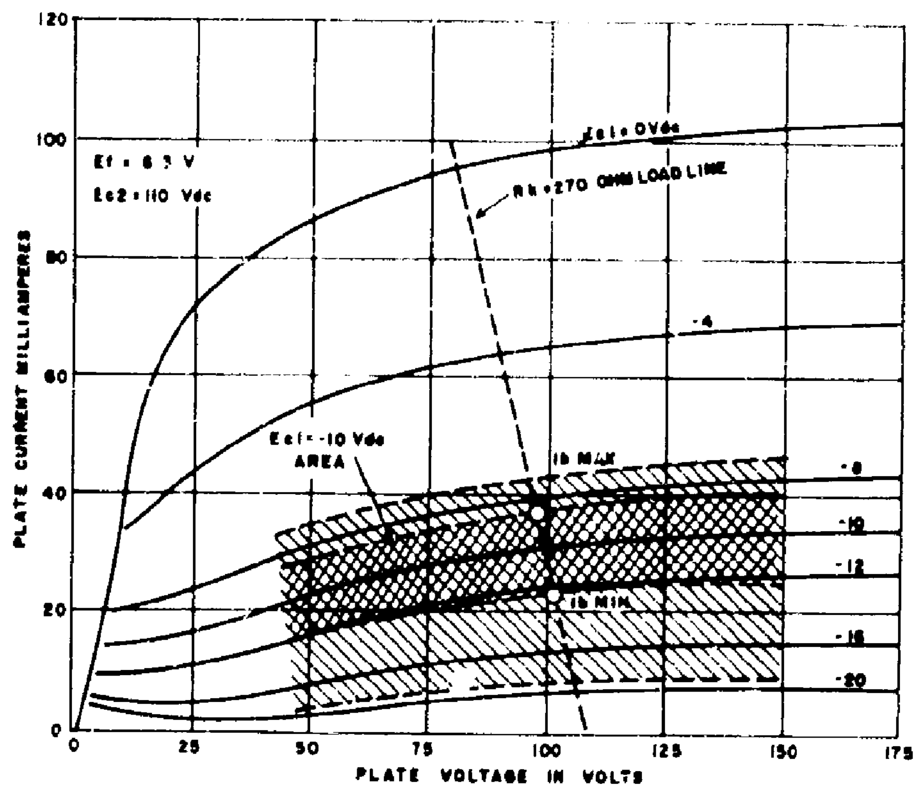


Figure 3-312. Limit Behavior of Tube Type JAN-5902 Static Plate Data; Variability of Ib

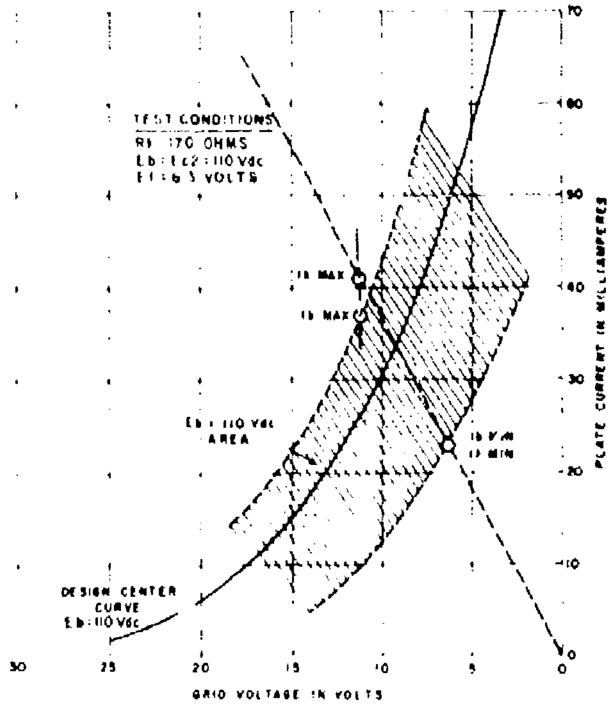


Figure 3-313. Transfer Curve Variability Permitted by Specification for Tube Type JAN-5902

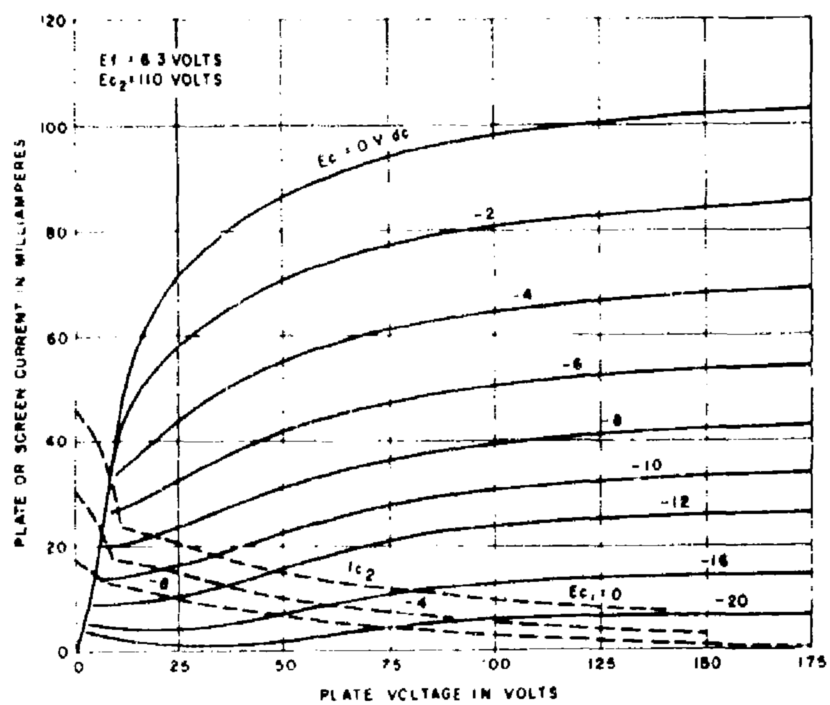


Figure 3-314. Typical Plate Characteristics for Tube Type JAN-5902

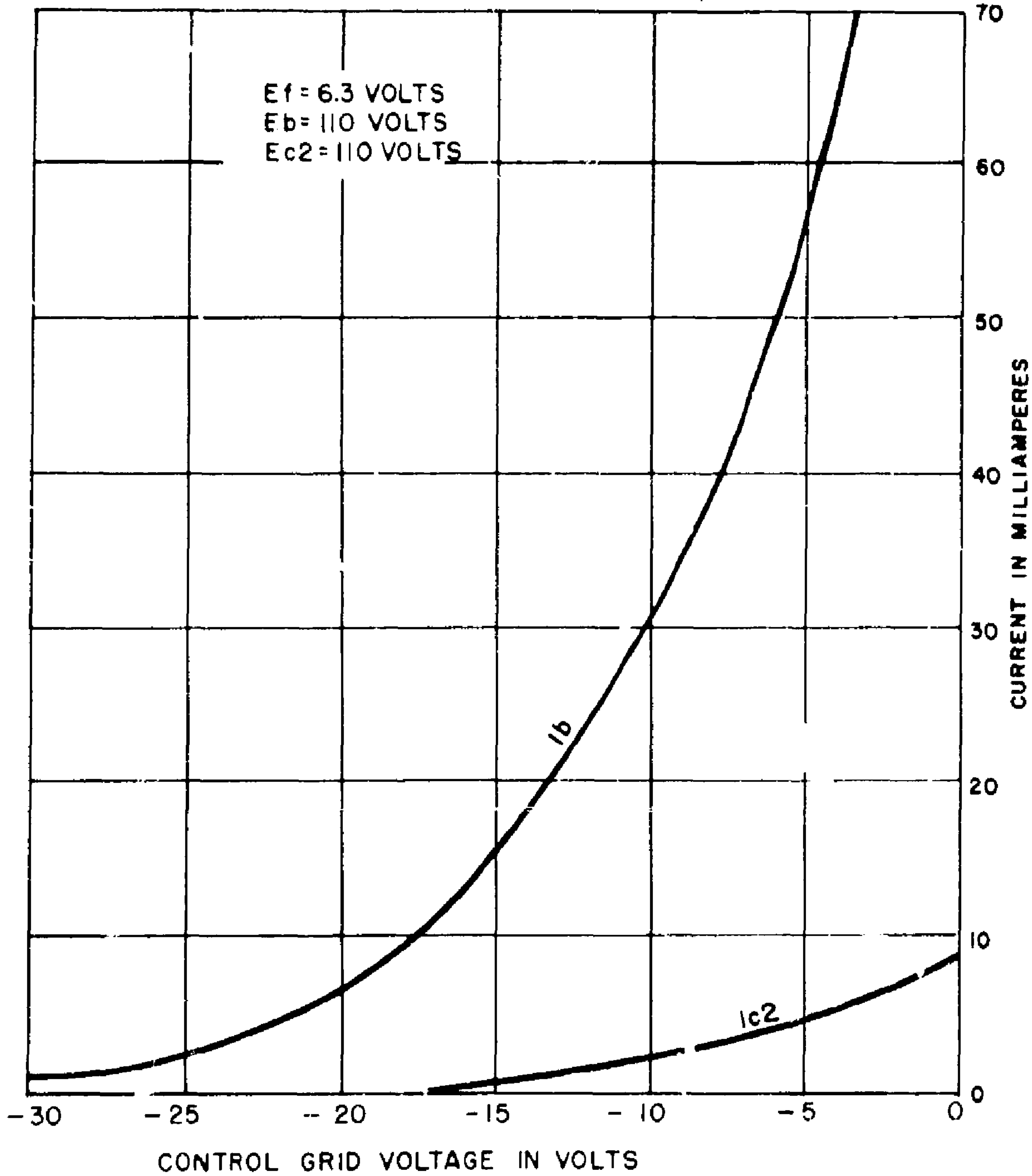


Figure 3-315. Typical Plate and Screen Transfer Characteristics of Tube Type JAN-5902

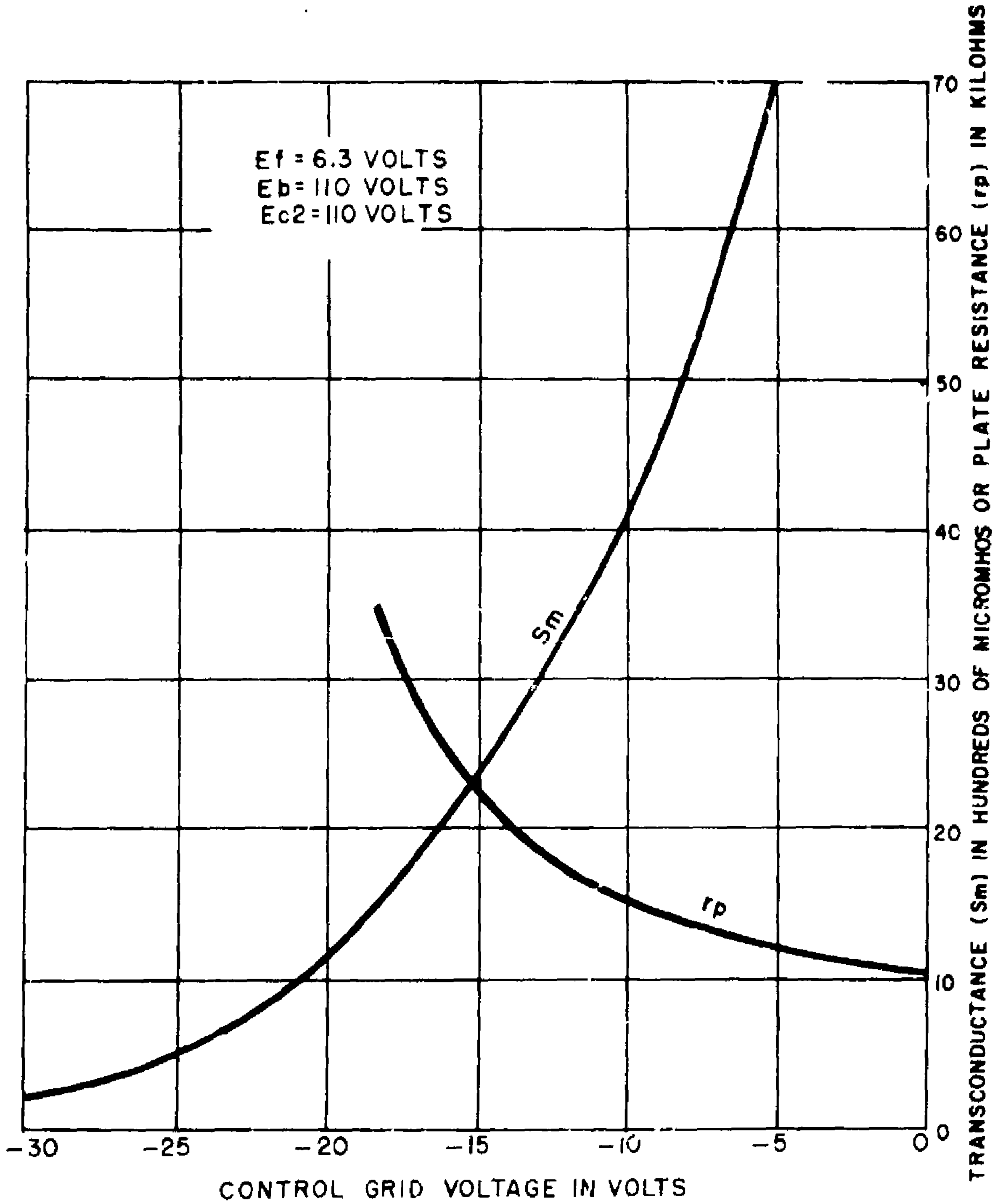


Figure 3-316. Typical Sm and Rp Characteristics of Tube Type JAN-' 902

SECTION 51

TUBE TYPE JAN-6005/6AQ5W

3.51 DESCRIPTION.

3.51.1 The JAN-6005/6AQ5W 1/ is a 7 pin miniature beam power pentode having a transconductance in the range from 3000 to 5200 micromhos.

3.51.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage	6.3 V
Heater Current, Design Center	450 mA
** Cathode	Coated Unipotential

3.51.3 MOUNTING. Not specified.

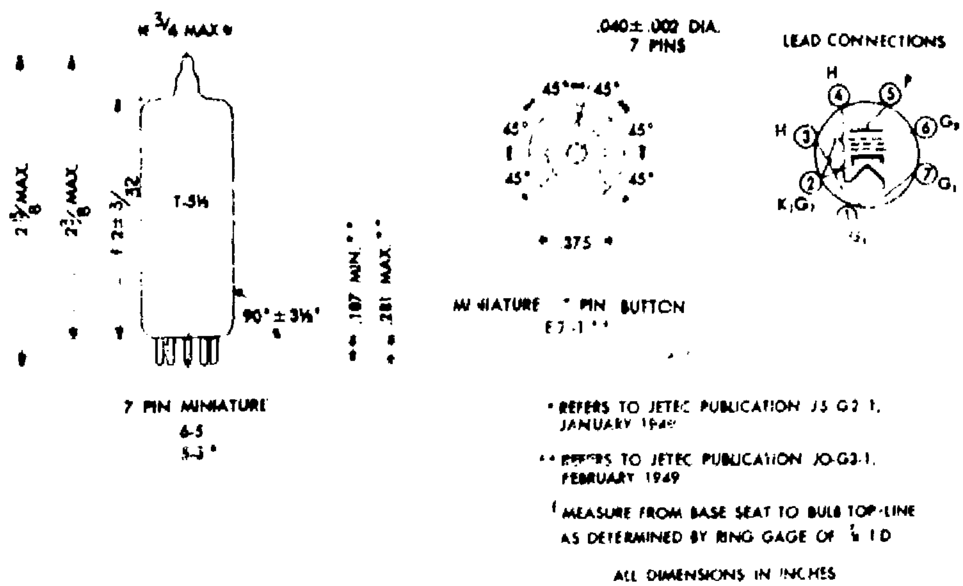


Figure 3-317. Outline Drawing and Base Diagram of Tube Type JAN-6005/6AQ5W

3.51.4 RATINGS, ABSOLUTE SYSTEM.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

1/ The values and specification comments presented in this section are related to MIL-E-1/13A dated 13 January 1953.

3.51.5 The absolute system ratings are as follows:

Heater Voltage	6.3 V ± 10%
Plate Voltage	275 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Screen Grid Voltage	275 Vdc
Heater-Cathode Voltage	±100 V
Plate Dissipation	13.2 W
Screen Grid Dissipation	2.2 W
* Bulb Temperature	225°C
* Altitude	10,000 ft

3.51.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.51.7 Test con ons and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	250 Vdc
Control Grid Voltage, Ec1	-12.5 Vdc
Screen Grid Voltage, Ec2	250 Vdc
Heater Current, If	450 mA
Plate Current, Ib	45 mA
Input Capacity, Cin	8.3 uuf
Output Capacity, Cout	7.5 uuf

3.51.8 ACCEPTANCE TEST LIMITS.

3.51.9 Table 3-84 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/13A dated 20 May 1953 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.51.10 APPLICATION.

3.51.11 Figure 3-318 shows the permissible operating area for JAN-6005/6AQ5W as defined by the ratings in MIL-E-1/175B dated 26 October 1954. A discussion of the permissible operating area for pentodes may be found in paragraph 3.2.2.

3.51.12 Table 3-85 lists general considerations for the applications of this type. The numbers refer to the applicable section or paragraph of this Manual.

* No test at this rating exists in the specification.

TABLE 3-84. ACCEPTANCE TEST LIMITS OF JAN-6005/6AQ5W

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		410	490	410	490	mA
Plate Current	Ib		33	57	---	---	mAdc
Screen Grid Current	Ic2		---	7.5	---	---	mAdc
Power Output (1)		Esig=8.8 Vac Rp = 5000	3.4	---	2.3	---	W
Power Output (2)	Po	Esig = 8.8 Vac Rp = 5000 Ef = 5.5 V	3.2	---	---	---	W
Change of Average	Δ Avg Po		---	---	---	17	%
Capacitance (Unshielded)	Cglp	Ef = 0	---	0.70	---	---	uuf
	Cin	Ef = 0	6.6	10.0	---	---	uuf
	Cout	Ef = 0	6.0	9.0	---	---	uuf
Grid Current	Icl	Rgl=0.5 Meg	---	-2.0	---	-4.0	uAdc
Grid Emission	Iscl	Ef=7.5 V; Ecl=50 Vdc; Rgl=0.5 Meg	---	-2.0	---	---	uAdc
Heater-Cathode Leakage	Ihk	Ehk = 100 Vdc	---	30	---	30	uAdc
	Ihk	Ehk = -100 Vdc	---	-30	---	30	uAdc
Insulation of Electrodes	R(gl-all)	Egl-all = -100Vdc	100	---	---	---	Meg
	R(p-all)	Ep-all = -300 Vdc	100	---	---	---	Meg

TABLE 3-85. APPLICATION PRECAUTIONS FOR JAN-6005/6AQ5W

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Heater-Cathode, 1.3.30
Plate:
- High, 3.2.12
- Low, 3.2.3, 3.2.7
- 28 Volt, 3.2.21
- AC Operation, 1.3.20, 3.2.18

Screen Grid:
- Supply, 3.2.8
- Protection, 3.2.22

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
- Cathode, 2.1.3, 3.2.15

Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Temperature

Bulb and Environmental, 3.2.4

Current

Cathode, 1.3.50, 3.2.6, 3.2.13
Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9

Current (Cont.)

Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.3

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.2.15

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.2.23

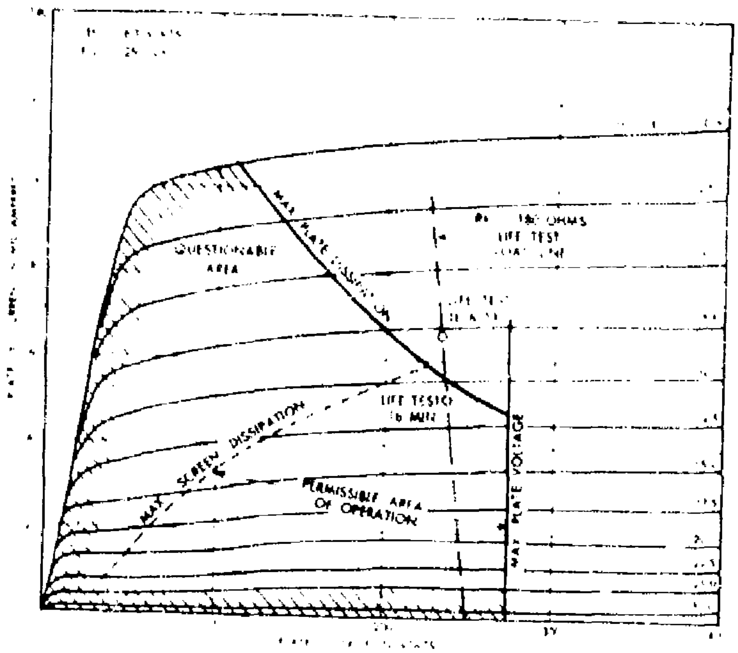


Figure 3-318. Typical Plate Characteristics of JAN-6005/6AQ5W; Permissible Area of Operation

3.51.13 VARIABILITY OF CHARACTERISTICS.

3.51.14 The following charts show the variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.51.15 Figure 3-319 presents the limit behavior of static plate characteristics for JAN-6005/6AQ5W as defined by MIL-E-1/134 dated 13 January 1953.

3.51.16 Figure 3-320 presents the limit behavior of transfer data for JAN-6005/6AQ5W as defined by MIL-E-1/134 dated 13 January 1953.

3.51.17 DESIGN CENTER CHARACTERISTICS.

3.51.18 The following typical curves, Figures 3-322 through 3-326 have been obtained from data published by the original RETMA registrant of this type.

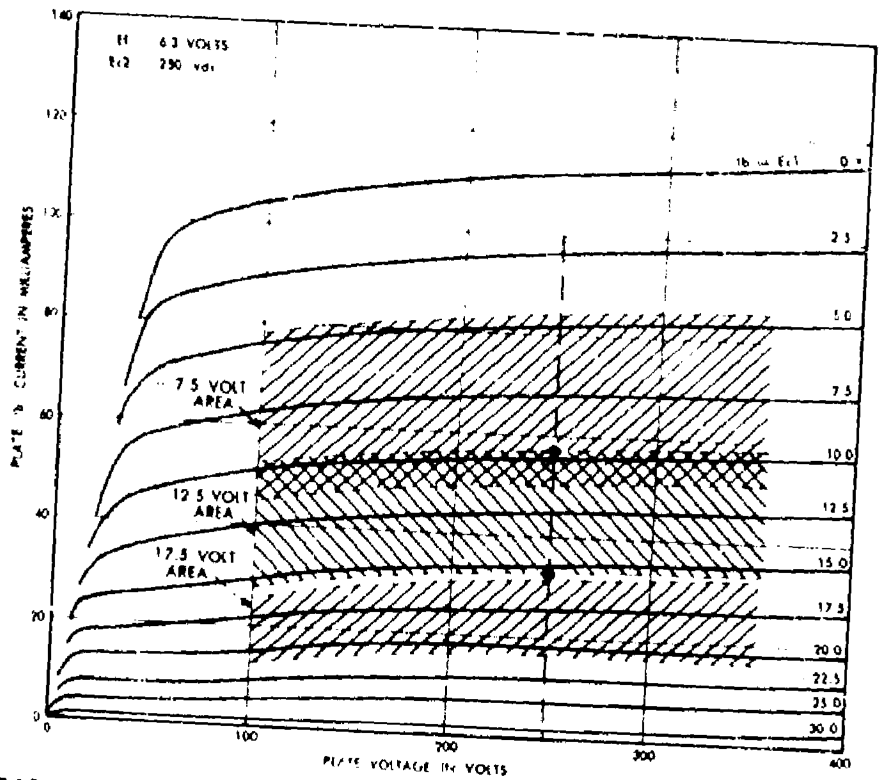


Figure 3-319. Limit Plate Characteristics of JAN-6005/6AQ5W; Variability of Ib

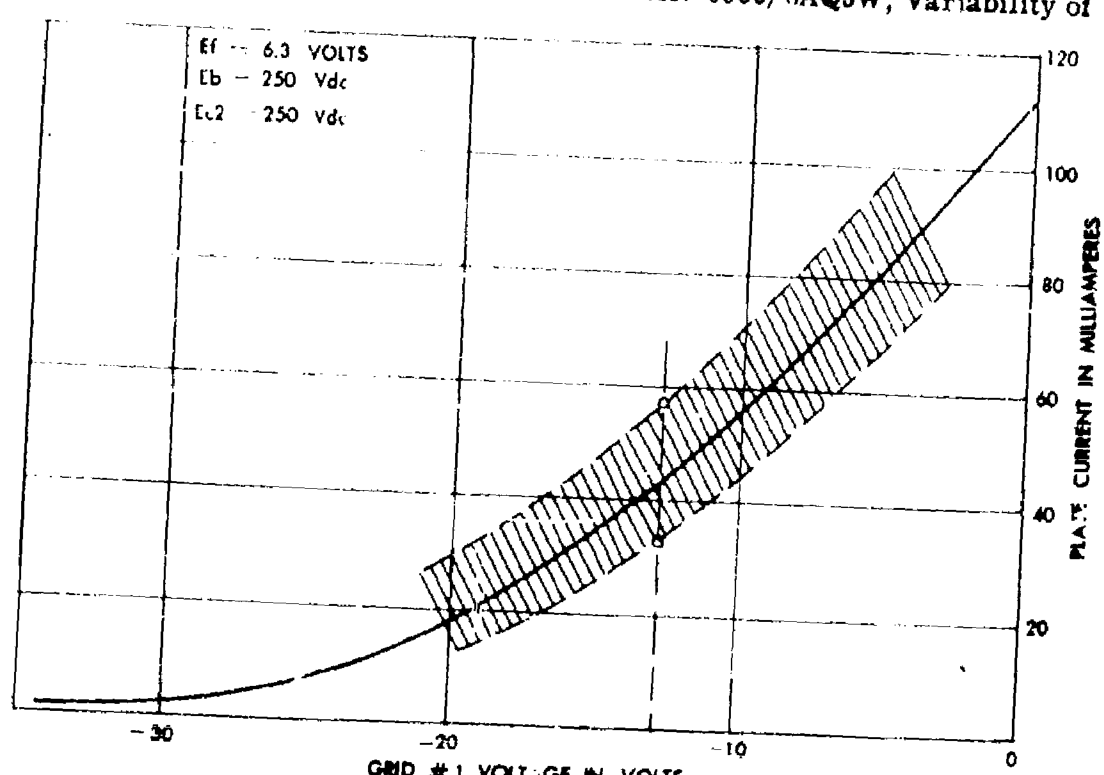


Figure 3-320. Limit Transfer Characteristics of JAN-6005/6AQ5W

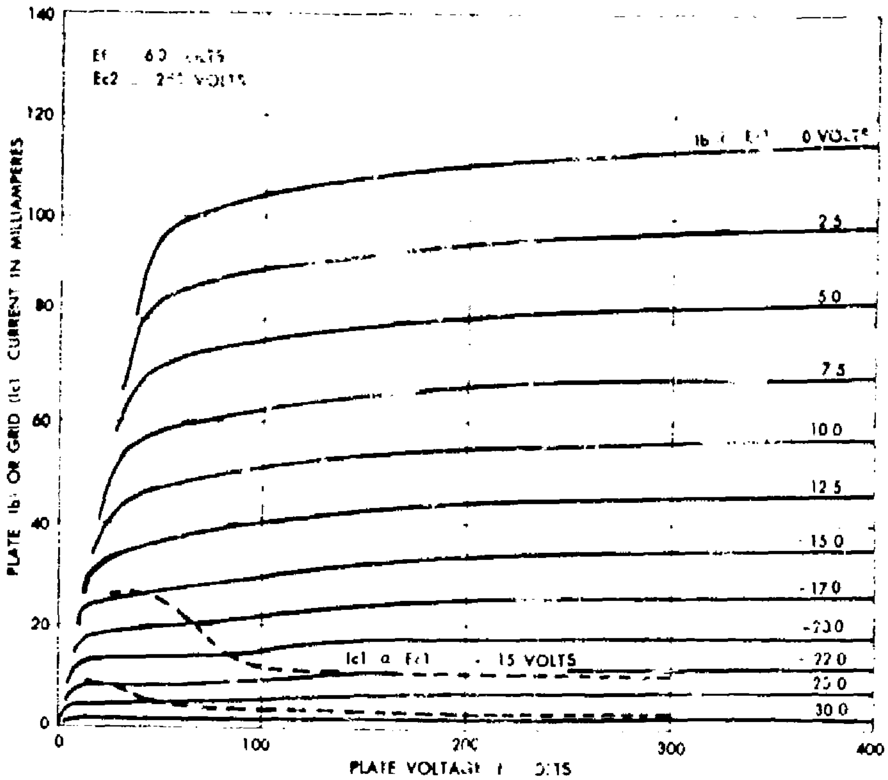


Figure 3-321. Typical Plate Cha···cteristics of JAN-6005/6AQ5W

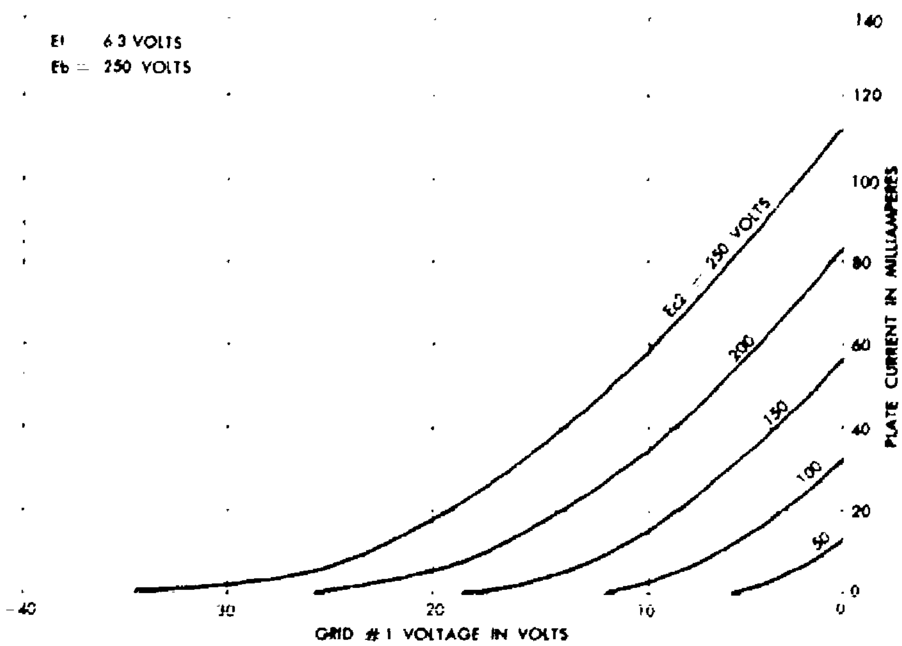


Figure 3-322. Typical Transfer Characteristics of JAN-6005/6AQ5W

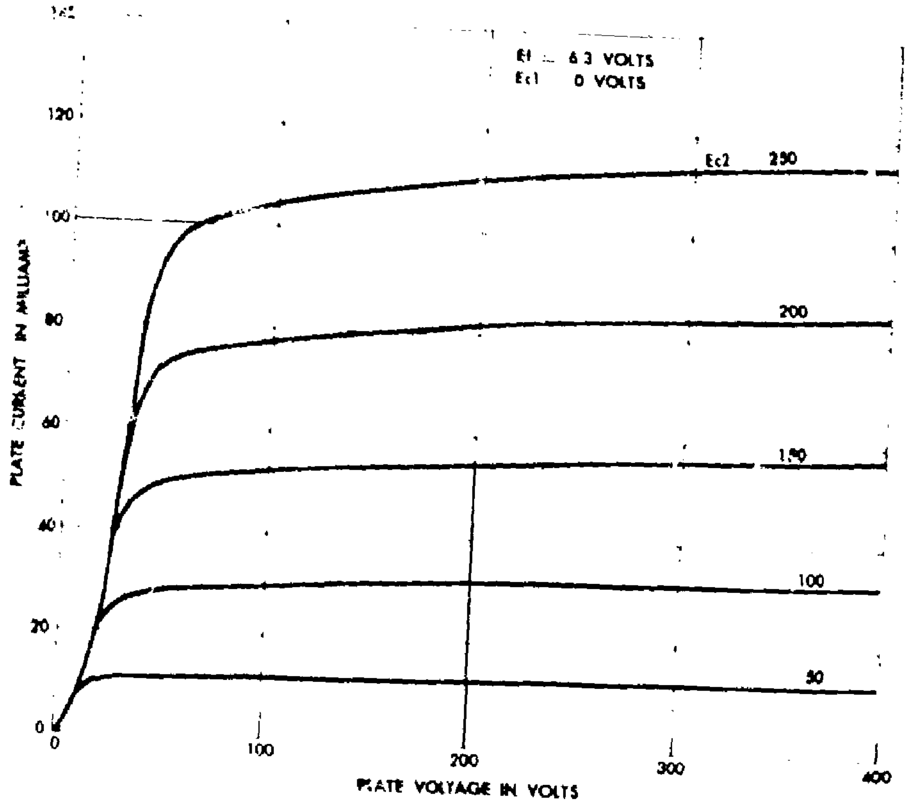


Figure 3-323. Typical Plate Characteristics of JAN-6005/6AQ5W

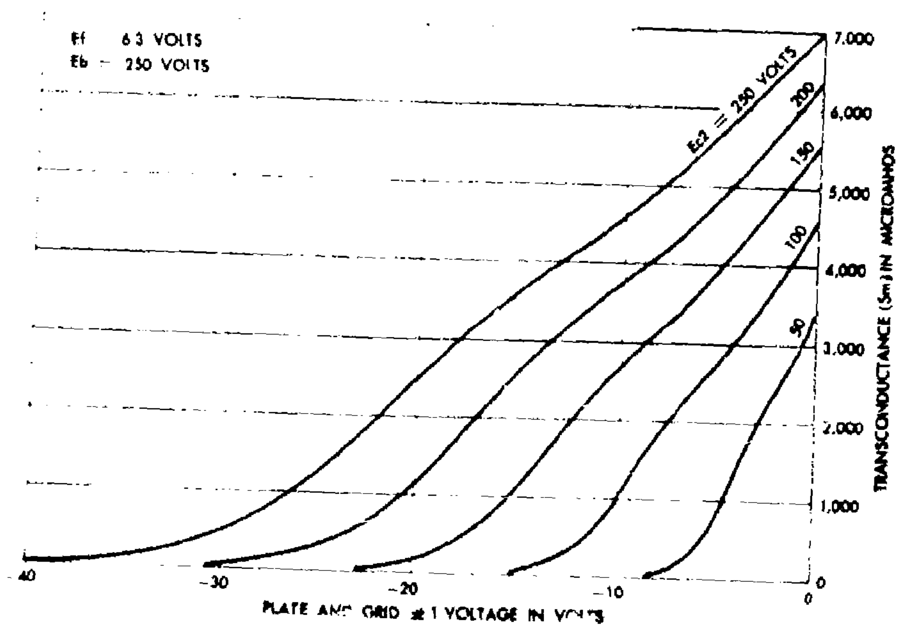


Figure 3-324. Typical Characteristics of JAN-6005/6AQ5W; Sm as a Function of Ec1, Parametric in Ec2

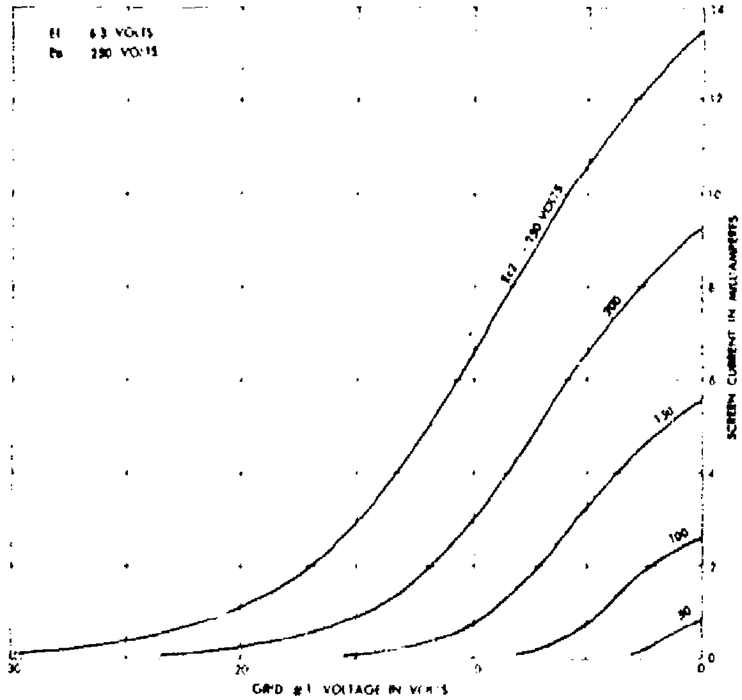


Figure 3-325. Typical Screen Transfer Characteristics of JAN-6005/6AQ5W

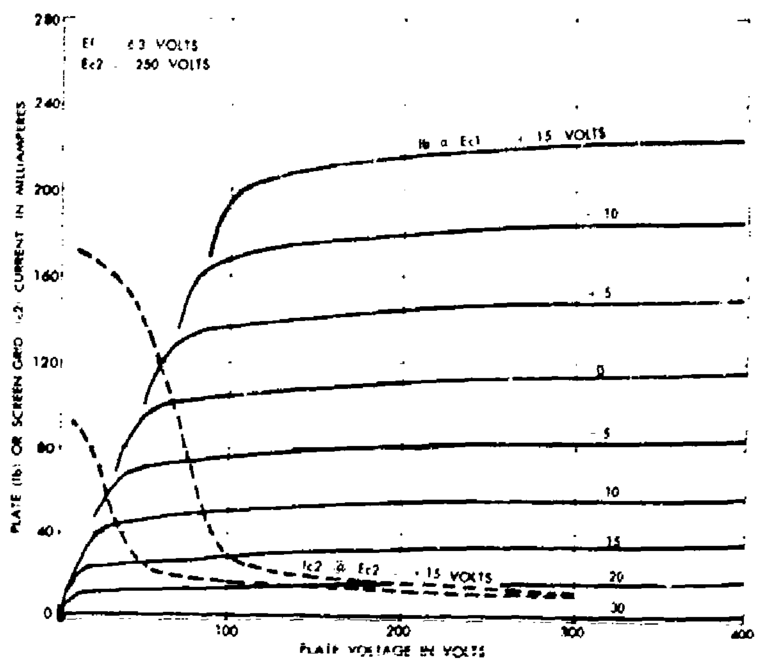


Figure 3-326. Typical Plate and Grid Characteristics of JAN-6005/6AQ5W

action

SECTION 52

TUBE TYPE JAN-6021

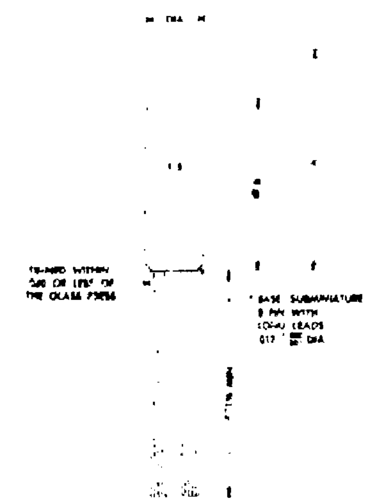
3.52 DESCRIPTION.

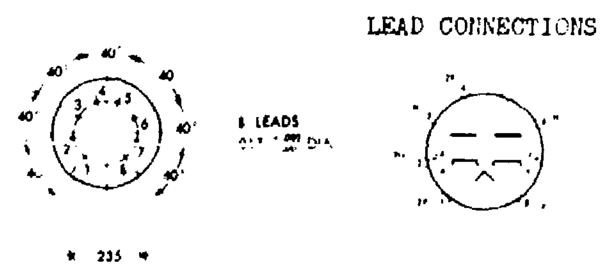
3.52.1 The JAN-6021 1/ is an 8-lead, button-base subminiature twin- triode having a design center Mu of 35 and transconductance of 5400. The JAN-6021 is similar in plate characteristics to the miniature type JAN-5670.

3.52.2 ELECTRICAL. Electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 300 mA
Cathode . . . . Coated Unipotential

3.52.3 MOUNTING. Not specified.





DIMENSIONS			
MAX.	B DIM	B TOL. ±	DIAMETER MAX.
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-327. Outline Drawing and Base Diagram of ube Type JAN-6021

1/ The values and specification comments presented in this section are related to MIL-E-1/188B dated 23 August 1955.

3.52.4 RATINGS, ABSOLUTE SYSTEM.

3.52.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Grid Voltage, Maximum	0 Vdc
Grid Voltage, Minimum	-55 Vdc
Heater-Cathode Voltage	200 v
Grid Series Resistance	1.1 Meg
** Plate Current	22 mAdc
* Grid Current	5.5 mAdc
Plate Dissipation	0.7 W
Bulb Temperature	+220°C
Altitude Rating	60,000 ft

3.52.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.52.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Cathode Resistance, Rk	150 ohms
Heater Current, If	300 mA
Plate Current, Ib	6.3 mAdc
Transconductance, Sm	5400 umhos
Amplification Factor, Mu	35

3.52.8 ACCEPTANCE TEST LIMITS.

3.52.9 Table 3-86 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/188B dated 23 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.52.10 APPLICATION.

3.52.11 Figure 3-328 shows the permissible operating area for JAN-6021 as defined by the ratings in MIL-E-1/188B dated 23 August 1955. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

---

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-86. ACCEPTANCE TEST LIMITS OF JAN-6021

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		280	320	276	328	mA
Transconductance (1)	Sm		4450	6350	---	---	umhos
Change in individuals	Δ Sm t		---	---	---	25	%
Transconductance (2)	Sm Δ Ef		---	15	---	15	%
Amplification Factor	Mu		30	40	---	---	
Plate Current (1)	Ib		4.5	8.5	---	---	mAdc
Plate Current (1) Difference between sections	Ib		---	1.6	---	---	mAdc
Pulse Emission	is	Ef = 6.0 V; E pulse = 50 v tp = 25 u sec; prr = 200 pps	300	---	---	---	ma
Capacitance	Cgp	Ef = 0	1.2	1.8	---	---	uuf
(Without Shielded)	Cin	Ef = 0	1.8	3.0	---	---	uuf
Section 1-	Cout	Ef = 0	0.20	0.36	---	---	uuf
Section 2-	Cout	Ef = 0	0.22	0.42	---	---	uuf
	Cgg	Ef = 0	---	0.013	---	---	uuf
	Cpp	Ef = 0	---	0.52	---	---	uuf
Grid Current	Ic	Eb = 150 Vdc; Rk = 300 Rg = 1.0 Meg	0	-0.3	0	-0.9	uAdc
Grid Emission	Ic	Ef = 7.5 V; Ec = -7.5 Vdc; Eb = 150Vdc; Rk = 0 Rg = 1.0 Meg	0	-0.5	---	---	uAdc
Heater-Cathode	Ihk	Ehk = +100 Vdc	---	5.0	---	10.	uAdc
Leakage	Ihk	Ehk = -100 Vdc	---	-5.0	---	-10.	uAdc
Insulation of Electrodes	R(g-all)	Eg-all = -100Vdc	100	---	50	---	Meg
	R(p-all)	Ep-all = -300Vdc	100	---	50	---	Meg

3.52.12 Table 3-87 lists general considerations for the application of this type. The numbers refer to the applicable paragraphs of this Manual.

TABLE 3-87. APPLICATION PRECAUTIONS FOR JAN-6021

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
High, 3.1.8
Low, 3.1.15
AC Operation, 1.3.20, 3.1.10
28 Volt, 3.1.15
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.1.3
Cathode, 2.1.3, 3.1.12
Fixed, 1.3.8, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.52.13 In addition to the considerations noted above, JAN-6021, as reflected in specification MIL-E-1/188B, provides additional assurance of pulse operation, initially at least, by an acceptance test requirement of 300 ma minimum peak plate current with pulse voltage applied.

3.52.14 VARIABILITY OF CHARACTERISTICS.

3.52.15 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.52.16 Figure 3-329 presents the limit behavior of static plate characteristics JAN-6021 as defined by MIL-E-1/188B dated 23 August 1955.

3.52.17 Figure 3-330 presents the limit behavior of plate transfer data for JA 6021 as defined by MIL-E-1/188B dated 23 August 1955.

3.52.18 DESIGN CENTER CHARACTERISTICS.

3.52.19 These typical curves have been obtained from data published by the ori nal RETMA registrant of this type.

3.52.20 Figure 3-331 presents the static plate characteristics of JAN-6021.

3.52.21 Figure 3-332 presents the typical plate transfer data for JAN-6021.

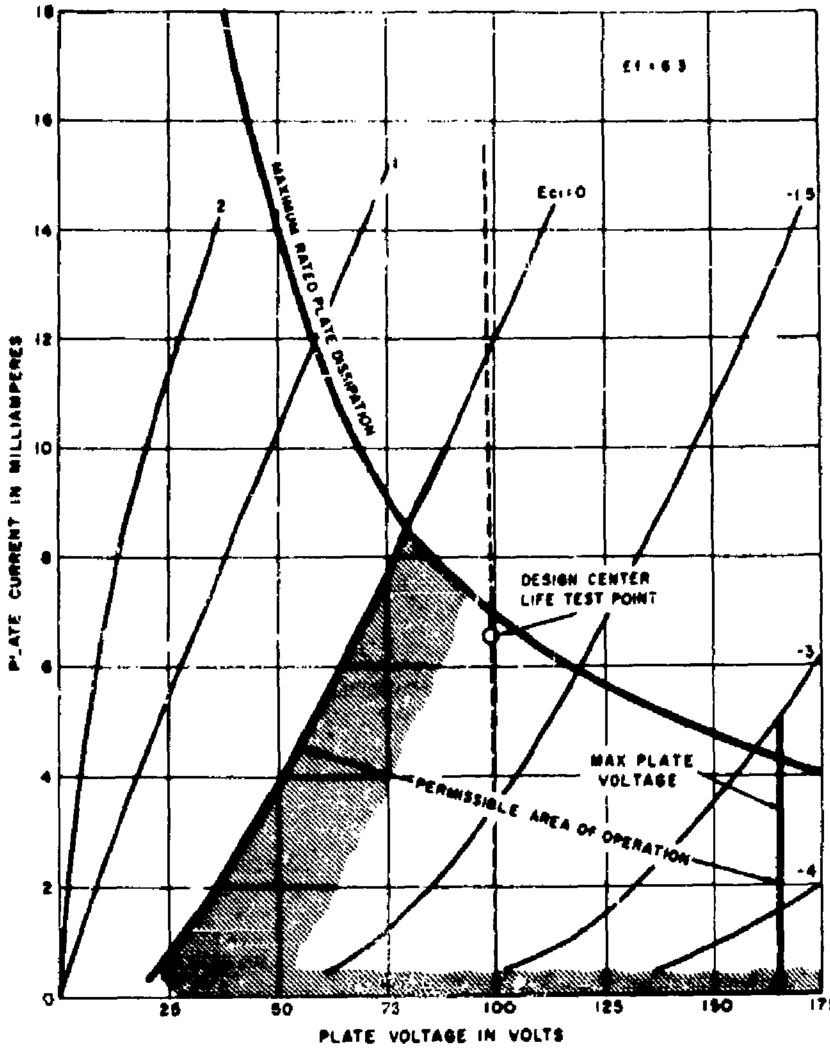


Figure 3-328. Typical Static Characteristics of Tube Type JAN-6021: Permissible Area of Operation

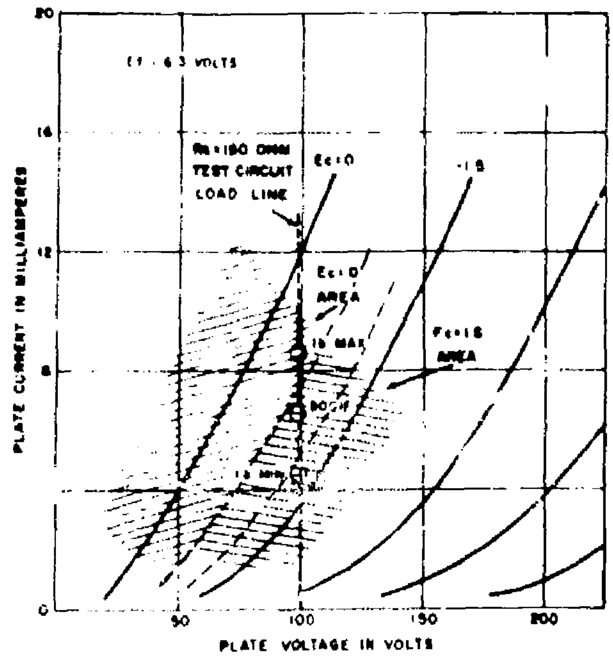


Figure 3-329. Limit Behavior of Tube Type JAN-6021 Static Plate Data; Variability of Ib

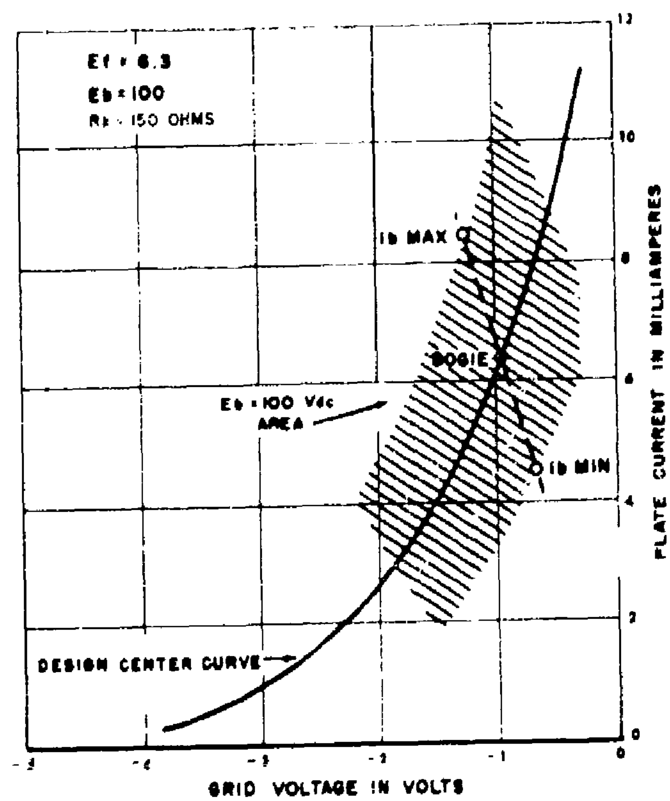


Figure 3-330. Limit Behavior of Transfer Data for Tube Type JAN-6021

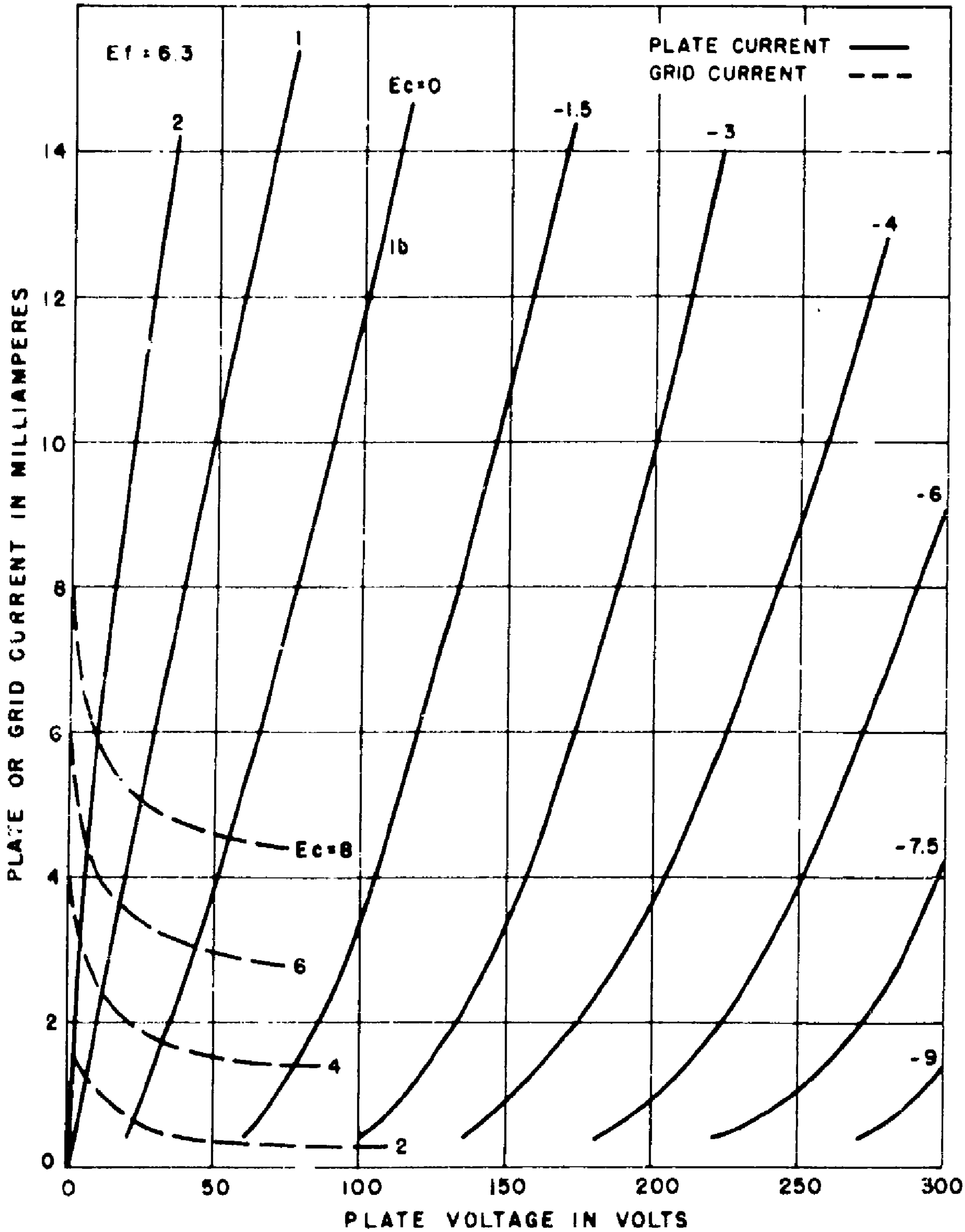


Figure 3-331. Typical Static Characteristics of Tube Type JAN-6021

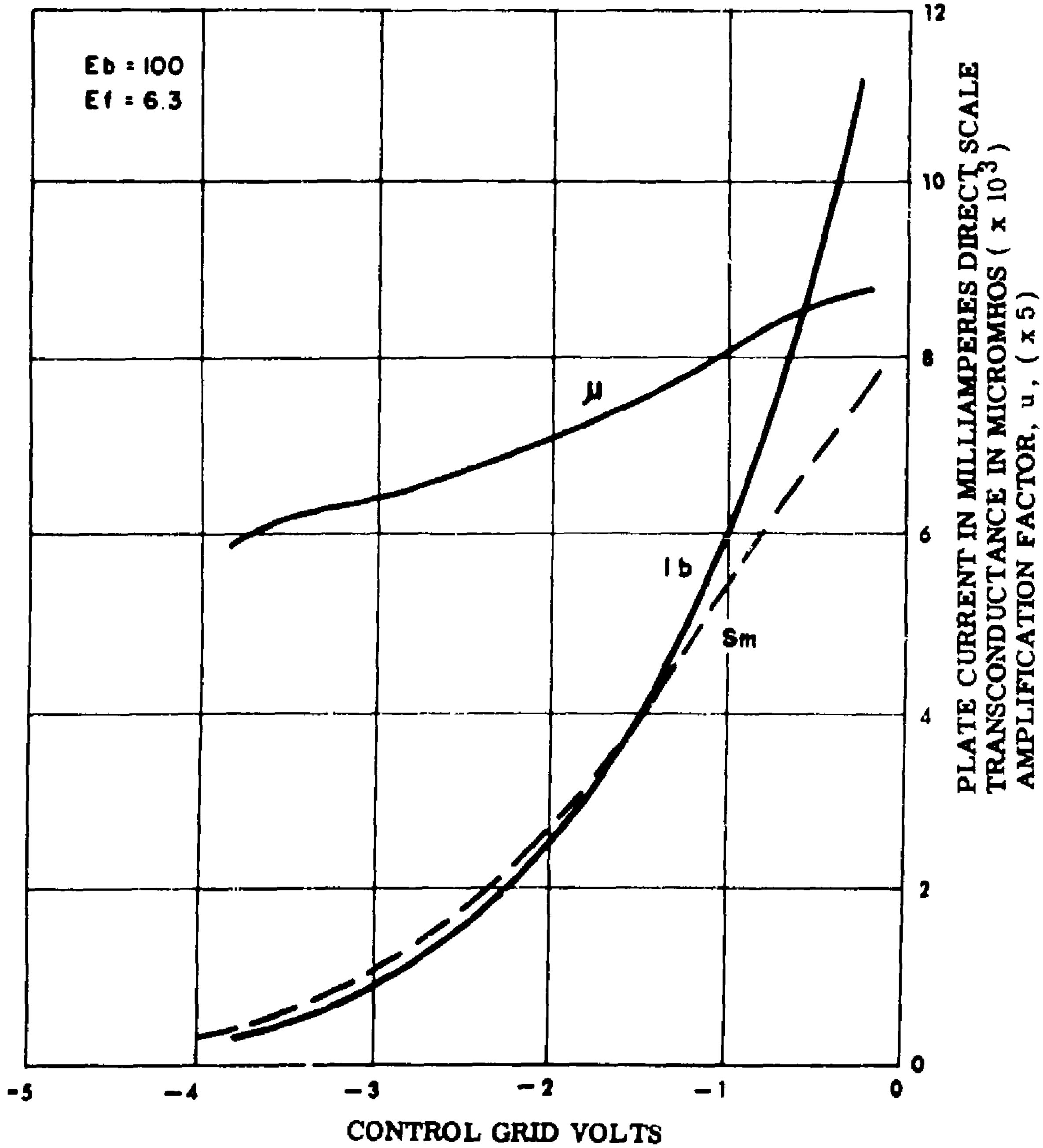


Figure 3-332. Typical Plate Transfer Data for Tube Type JAN-6021

SECTION 53

TUBE TYPE JAN-6080WA

3.53 DESCRIPTION.

3.53.1 The JAN-6080WA 1/ is an 8 pin, octal based low mu, twin power triode.

3.53.2 ELECTRICAL. The electrical characteristics are as follows:

Heater Voltage, AC or DC . . . . 6.3 V
Heater Current . . . . 2.35 to 2.65 A
Cathode . . . . Coated Unipotential

3.53.3 MOUNTING. Not specified.

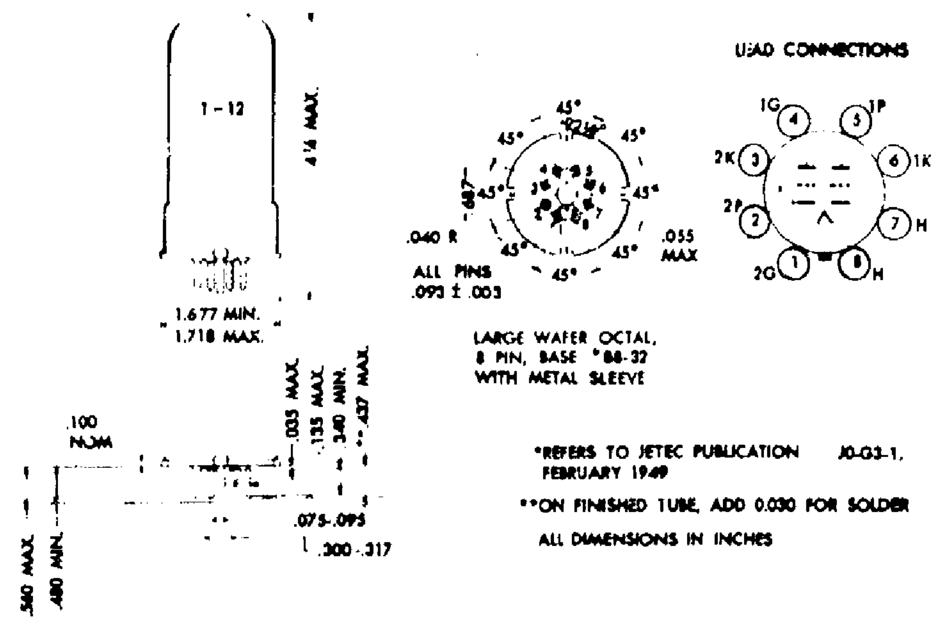


Figure 3-333. Outline Drawing and Base Diagram of Tube Type JAN-6080WA

3.53.4 RATINGS, ABSOLUTE SYSTEM.

3.53.5 The absolute system ratings are as follows:

Heater Voltage . . . . 6.3 ± 0.3 V
Plate Voltage . . . . 250 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Control Grid Voltage,
Maximum . . . . 0 Vdc

1/ The values and specification comments presented in this section are related to MIL-E-1/510B dated 5 December 1955.

Peak forward anode Voltage . . . . .3000 v
Heater-Cathode Voltage . . . . ±300 V
Maximum grid circuit Resistance
(a) Cathode bias operation . . . . 1.0 meg
(b) Fixed bias or a combination of fixed and cathode bias . . . . .0.1 meg
* Grid Current, per grid . . . . .5.0 mA
Plate Dissipation, per plate . . . . 13_0W
Bulb Temperature . . . . 230 C
Altitude . . . . .60,000 ft

3.53.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.53.7 Test conditions and design center characteristics are as follows:
Heater Voltage, Ef. . . . . 6.3 V
Plate Voltage, Eb . . . . 135 Vdc
Cathode Resistance, Rk per cathode . . . . 250 ohms
** Plate Current, Ib . . . . 125 mAdc
Transconductance .7000 umhos

3.53.8 ACCEPTANCE TEST LIMITS.

3.53.9 Table 3-88 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/510B dated 5 December 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.53.10 APPLICATION.

3.53.11 Figure 3-344 shows the permissible operating area for JAN-6080WA as defined by the ratings in MIL-E-1/510B dated 5 December 1955. A discussion of the permissible operating area for triodes may be found in paragraphs 3.1.2 through 3.1.5.

* No test at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of plate current.

TABLE 3-88. ACCEPTANCE TEST LIMITS OF JAN-6080WA

PROPERTY	MEASUREMENT CONDITIONS	LIMITS				UNITS
		INITIAL		LIFE TEST		
		MIN	MAX	MIN	MAX	
Heater Current If		2.35	2.65	2.35	2.75	A
Transconductance (1) Sm		6000	8200	5500	---	umhos
Transconductance (2) $\Delta \frac{Sm}{Ef}$		---	10	---	10	%
Plate Current (1) Ib		100	150	---	---	mAdc
Plate Current (1) Ib difference between sections		---	25	---	---	mAdc
Plate Current (2) Ib	Eb = 250 Vdc Ec = -200Vdc	---	10	---	---	mAdc
Insulation of electrodes Rg-all	Eg-all = -100Vdc	200	---	100	---	Meg
Rp-all	Ep-all = -300Vdc	200	---	100	---	Meg
Grid Current Ic	Rg = 1.0 Meg With both units operating, Ic is the sum of I1c and I2c	0	-2.0	0	-10	uAdc
Heater-Cathode Leakage Ihk	Ehk = +100Vdc	---	25	---	25	uAdc
Ihk	Ehk = -100Vdc	---	-25	---	-25	uAdc

TABLE 3-89. APPLICATION PRECAUTIONS FOR JAN-6080WA

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
High, 3.1.8
Low, 3.1.15
AC Operation, 1.3.20, 3.1.10
28 Volt, 3.1.15
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.1.3
Cathode, 2.1.3, 3.1.12
Fixed, 1.3.8, 2.1.3, 3.1.4
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emisssion, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.16

3.53.12 VARIABILITY OF CHARACTERISTICS.

3.53.13 The following charts show the variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.53.14 Figure 3-335 presents the limit behavior of static plate characteristics for JAN-6080WA as defined by MIL-E-1/510B dated 5 December 1955.

3.53.15 DESIGN CENTER CHARACTERISTICS.

3.53.16 These typical curves have been obtained from current data being published by the original RETMA registrant of this type.

3.53.17 Figure 3-336 presents the Static Plate Characteristics of JAN-6080WA.

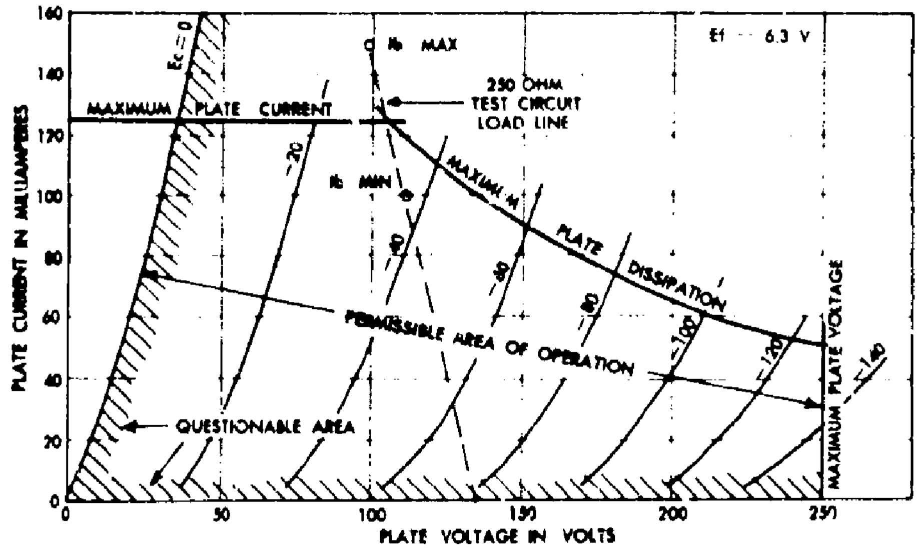


Figure 3-334. Typical Plate Characteristics of JAN-6080WA; Permissible Area of Operation

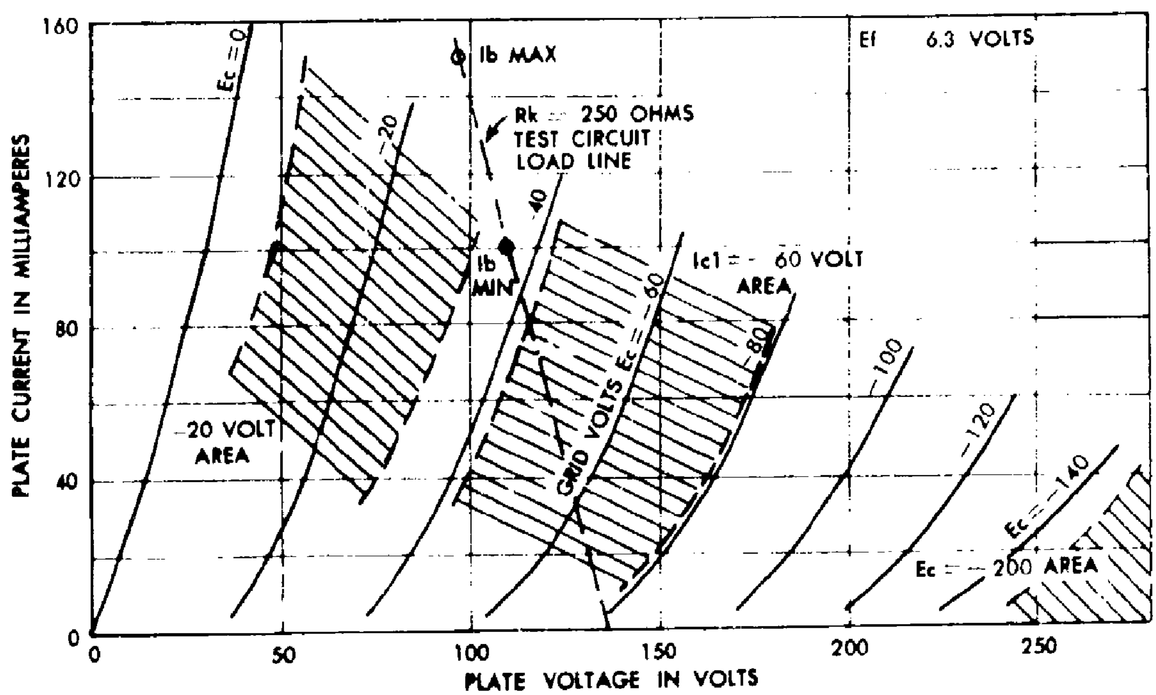


Figure 3-335. Limit Plate Characteristics of JAN-6080WA; Variability of Ib

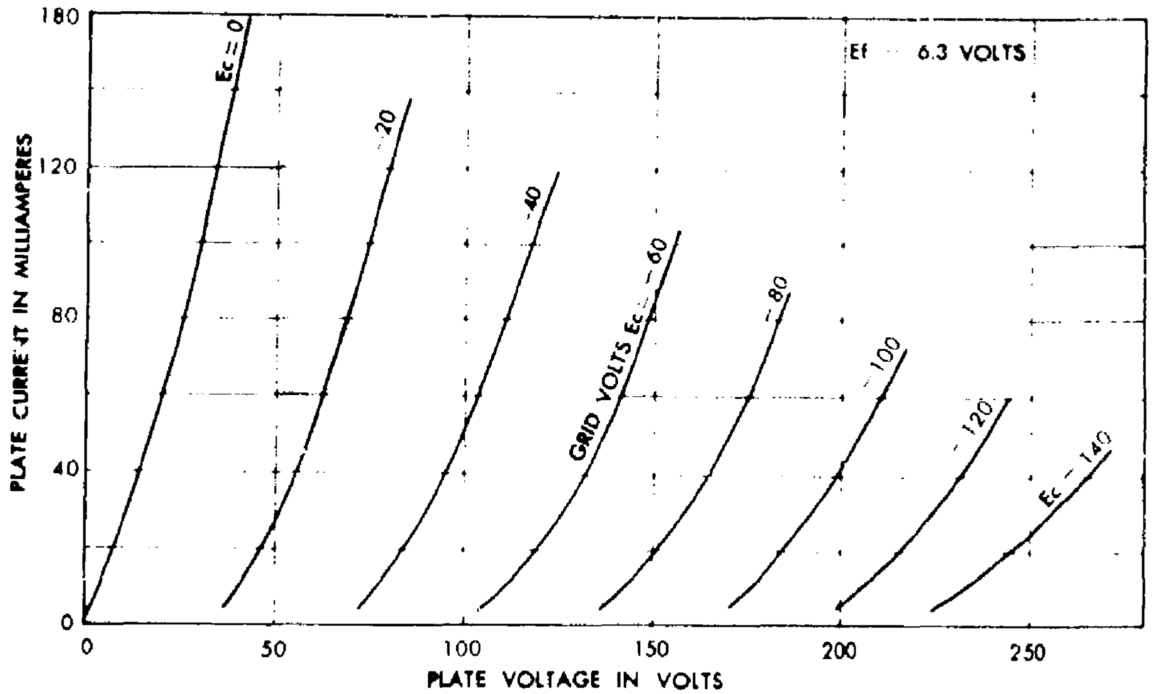


Figure 3-336. Typical Plate Characteristics of JAN-6080WA

SECTION 54

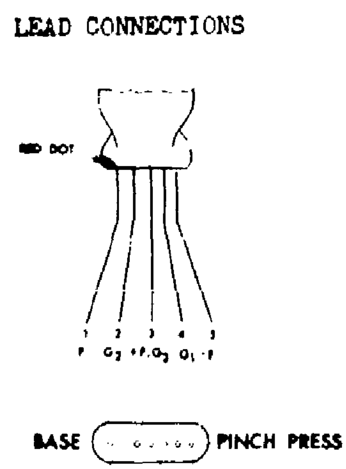
TUBE TYPE JAN-6088

3.54 DESCRIPTION.

3.54.1 The JAN-6088 1/ is a 5-lead, flat-press, filamentary, subminiature, power-amplifier pentode having a transconductance in the range, 400 to 720 micromhos.

3.54.2 ELECTRICAL. Electrical characteristics are as follows:
Heater Voltage . . . . 1.25 Vdc
Cathode . . . . Coated Filament

3.54.3 MOUNTING. Not specified.



DIMENSIONS				
A MAX.	B		DIAMETER MAX	
	DIM	TOL. ±	C MAX	D MAX
1.500	1.300	.100	.385	.285

ALL DIMENSIONS IN INCHES

\# MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

*** WHEN SPECIFIED ON THE TSS

**** APPLIES TO PINCH PRESS TYPES ONLY (.02 MIN.)

† GROUND LEAD OVERLAPPED BY SHIELD BY A MINIMUM OF .04

†† SHIELD TO GROUND WIRE MAY BE FROM EITHER SIDE OF THE MAJOR DIMENSION. ALTERNATIVE CONSTRUCTION: UNUSED OR EXTRA RANDOM LEAD IN PRESS OR BUTTON MAY BE FOLDED BACK AND WRAPPED AROUND BULB TO MAKE CONTACT WITH SHIELD.

Figure 3-337. Outline Drawing and Base Diagram of Tube Type JAN-6088

1/ The values and specification comments presented in this section are related to MIL-E-1/694 dated 3 May 1954.

3.54.4 RATINGS, ABSOLUTE SYSTEM.

3.54.5 The absolute system ratings are as follows:

\# Heater Voltage . . . . 1.25 Vdc ± 20%
Plate Voltage . . . . 67.5 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage
Screen Grid Voltage . . . . 67.5 Vdc
* Cathode Current, Maximum . . . . 1.5 mAdc
* Altitude Rating . . . . 10,000 ft

3.54.6 TEST CONDITIONS.

3.54.7 Test conditions are as follows:

Heater Voltage, Ef . . . . 1.25 Vdc
Plate Voltage, Eb . . . . 45 Vdc
Control Grid Voltage, Ec1 . . . . -1.25 Vdc
Screen Grid Voltage, Ec2 . . . . 45 Vdc

3.54.8 ACCEPTANCE TEST LIMITS.

3.54.9 Table 3-90 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/694 dated 3 May 1954 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions unless otherwise indicated.

TABLE 3-90. ACCEPTANCE TEST LIMITS OF JAN-6088

PROPERTY	MEASURE-MENT CONDITIONS	LIMITS				UNITS
		INITIAL		LIFE TEST		
		MIN	MAX	MIN	MAX	
Heater Current If		17.5	22.5	---	---	mA
Transconductance (1) Sm		400	720	---	---	umhos
Plate Current (1) Ib		450	900	---	---	uAdc
Screen Grid Current Ic2		---	230	---	---	uAdc
Power Output Po	Esig = 0.9 Vac Rg1 = 5.0 Meg Rp = 0.2 Meg	6.3	---	4.5	---	mW
Control Grid Current Ic1	Ec1 = -50 Vdc	0	-1.0	---	---	uAdc

\# Concerning this rating, MIL-E-1/694 for JAN-6088 states, "Do not use series filament circuits."

* No test of operation at this rating exists in the specification.

3.54.10 APPLICATION.

3.54.11 Figure 3-338 shows the permissible operating area for JAN-6088 as defined by the ratings in MIL-E-1/694 dated 3 May 1954. A discussion of the permissible operating area for pentodes may be found in paragraph 3.1.2.

3.54.12 Table 3-91 lists general considerations for the applications of this type. The numbers refer to the applicable paragraphs of this Manual.

TABLE 3-91. APPLICATION PRECAUTIONS FOR JAN-6088

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.2.14
Plate:
High, 3.2.12
Low, 3.2.3, 3.2.7
28 Volt, 3.2.21
AC Operation, 1.3.20, 3.2.18
Screen Grid:
Supply, 3.2.8
Protection, 3.2.22
Control Grid Bias:
Low, 1.3.4, 1.3.9, 3.2.8, 3.2.9
Cathode, 2.1.3, 3.2.15
Positive Grid Region, 3.2.19
Contact Potential, 1.3.4, 3.2.9, 3.2.21

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.2.16
Screen Grid Series, 3.2.3, 3.2.17
Cathode, 2.1.3, 3.2.15

Temperature

Bulb and Environmental, 3.2.4

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.2.9
Screen Grid, 3.2.3
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.2.9
Control Grid Emission, 1.3.18
Cathode, Thermionic Instability, 1.3.37

Dissipation

Plate, 2.1, 3.2.4
Screen Grid, 2.1, 3.2.3, 3.2.8

Miscellaneous

Pulse Operation, 3.2.19
Shielding, 3.2.4
Intermittent Operation, 3.2.13
Triode Connection, 3.2.20
Electron Coupling Effects, 1.3.44
Miscrophonics, 1.3.56, 3.2.23

3.54.13 SPECIAL OPERATING CONSIDERATIONS.

3.54.14 Specification for this type provides some degree of assurance initially and on life, of satisfactory performance in low-power applications through a power-output requirement of 6.3 milliwatts initial and 4.5 milliwatts life test end point, under test condition voltages with a signal voltage of 0.9 volts, Rgl = 5.0 Megohm

and Rp = 0.2 Megohm. Specification for this type cautions against its use in series filament circuits.

3.54.15 VARIABILITY OF CHARACTERISTICS.

3.54.16 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.54.17 Figure 3-339 presents the limit behavior of static plate characteristics for JAN-6088 as defined by MIL-E-1/694 dated 3 May 1954.

3.54.18 Figure 3-340 presents the limit behavior of plate transfer data for JAN-6088 as defined by MIL-E-1/694 dated 3 May 1954.

3.54.19 DESIGN CENTER CHARACTERISTICS.

3.54.20 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.54.21 Figure 3-341 presents the static plate characteristics of JAN-6088.

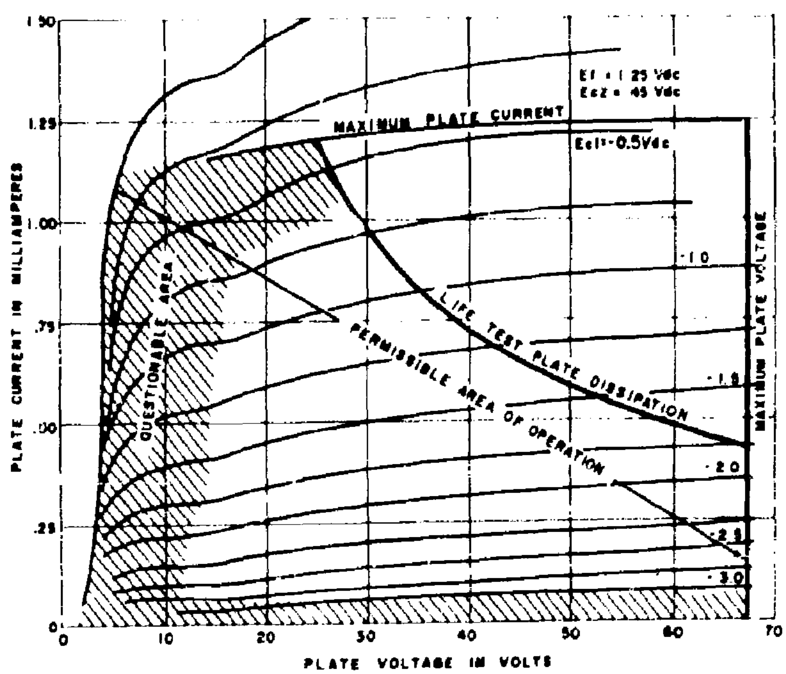


Figure 3-338. Typical Static Plate Characteristics of Tube Type JAN-6088; Permissible Area of Operation

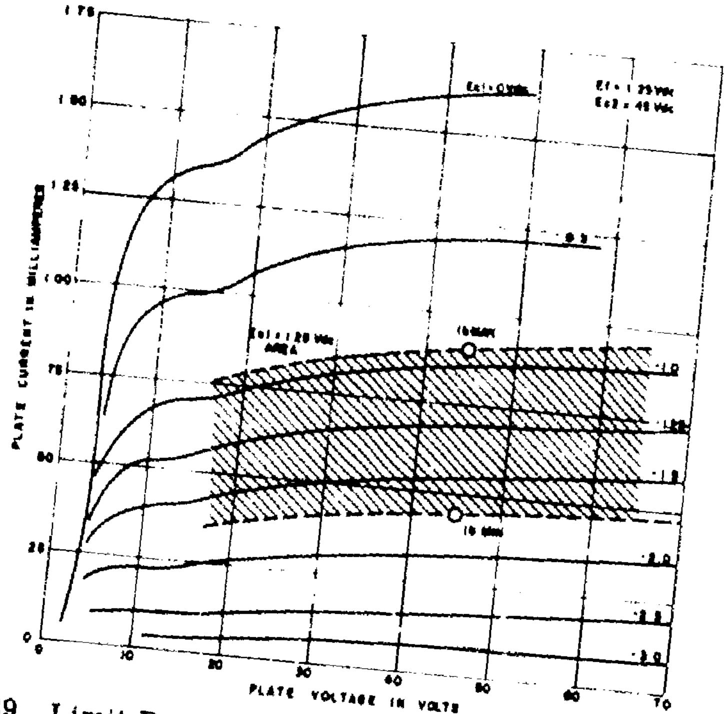


Figure 3-339. Limit Behavior of Tube Type JAN-6088 Static Plate Data; Variability of Ib

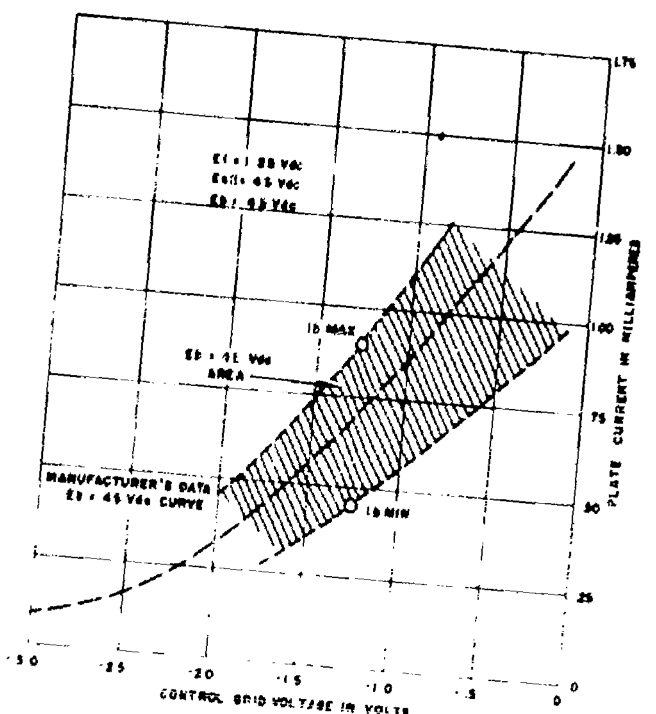


Figure 3-340. Limit Behavior of Tube Type JAN-6088 Transfer Data; Variability of Ib

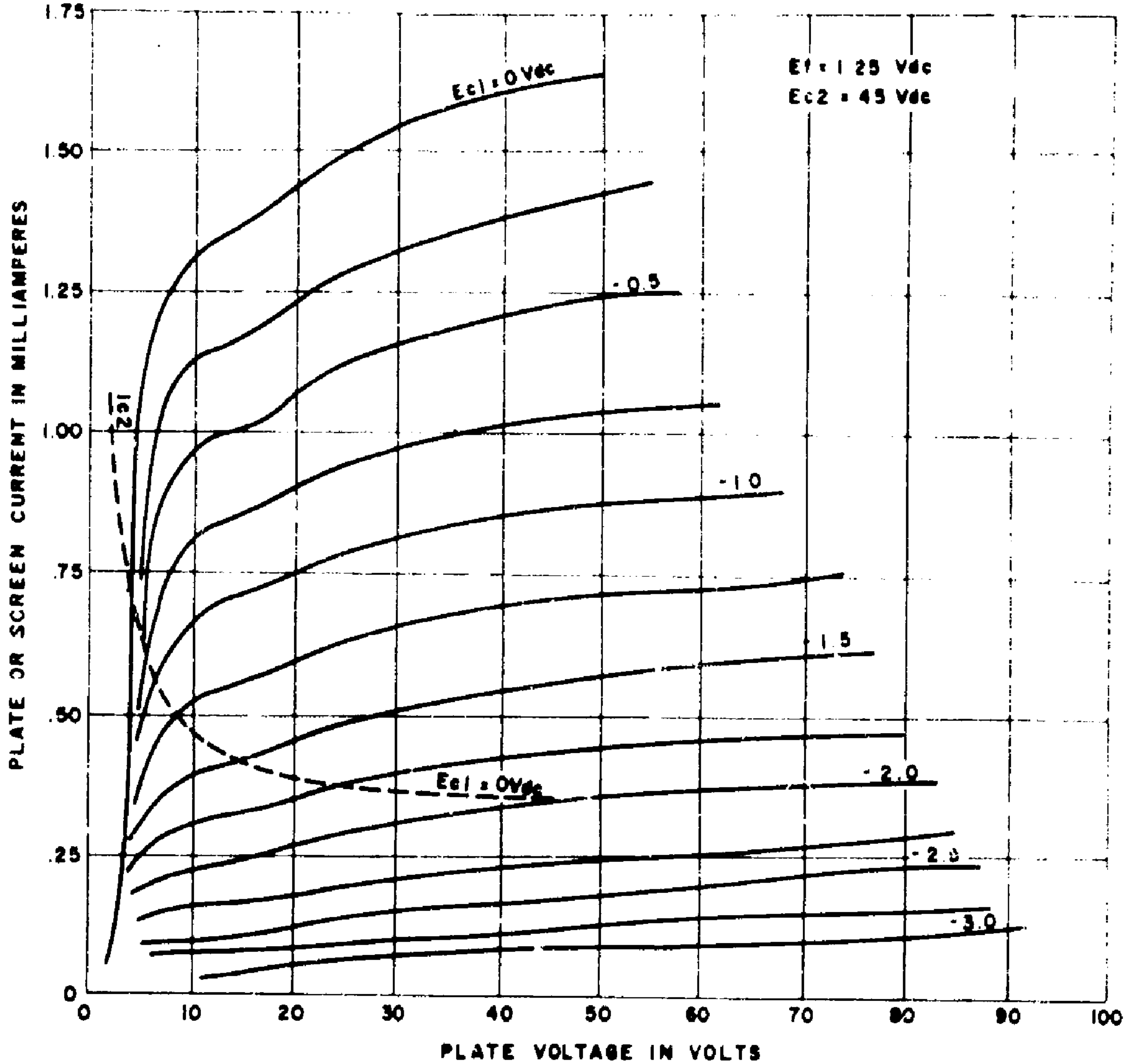


Figure 3-341. Typical Static Plate Characteristics of Tube Type JAN-6088

TUBE TYPE JAN-6111

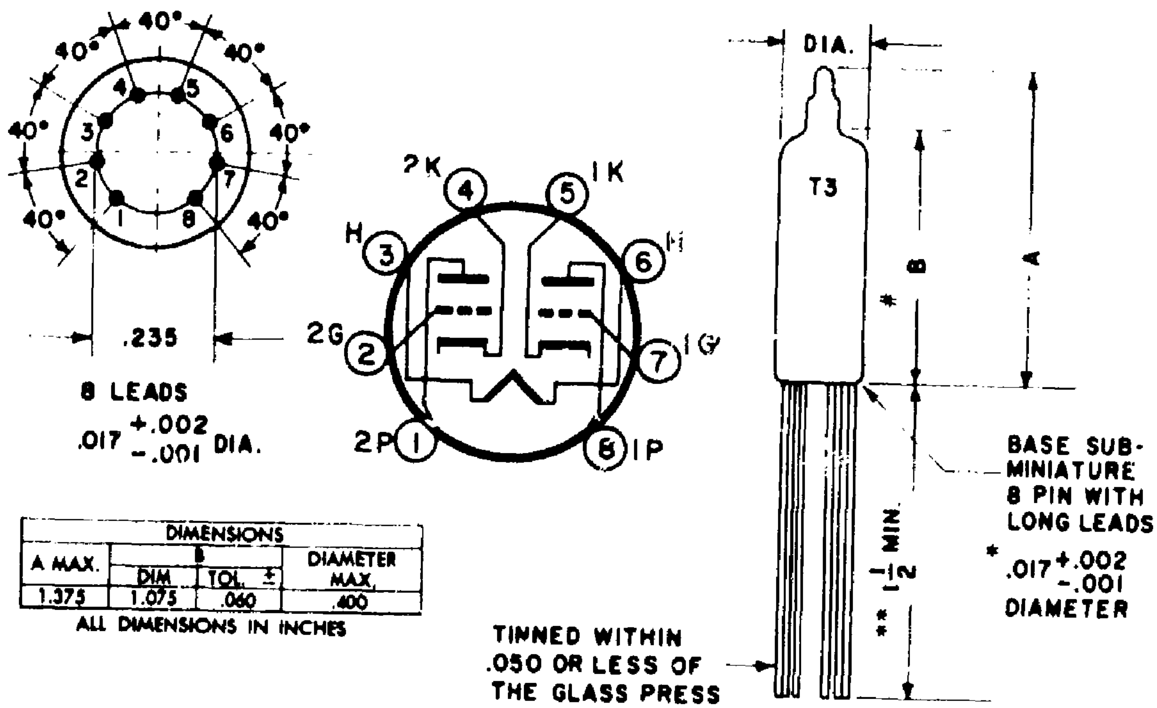
3.55 DESCRIPTION.

3.55.1 The JAN-6111 1/ is an 8-lead, button- base, subminiature twin triode having a design center amplification factor of 20, and transconductance of 5000. This type has been used successfully in a variety of amplifier applications, including pulse circuits.

3.55.2 ELECTRICAL. Electrical characteristics are as follows:

Heater Voltage	6.3 V
Heater Current, Design Center	300 mA
Cathode	Coated Unipotential

3.55.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX.
	DIM	TOL. ±	
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS.

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-342. Outline Drawing and Base Diagram of Tube Type JAN-6111

1/ The values and specification comments presented in this section are related to MIL-E-1/189B dated 23 August 1955.

3.55.4 RATINGS, ABSOLUTE SYSTEM.

3.55.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.3 V
Plate Voltage, Maximum	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Grid Voltage, Maximum	0 Vdc
Grid Voltage, Minimum	-55 Vdc
Heater-Cathode Voltage	200 v
Grid Series Resistance +	1.1 Meg
** Plate Current	22 mAdc
* Grid Current	5.5 mAdc
Plate Dissipation	0.95 W
Bulb Temperature	+220°C
Altitude Rating	60,000 ft

3.55.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.55.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Cathode Resistance	220 ohms
Plate Current, Ib	8.5 mAdc
Transconductance, Sm	5000 umhos
Amplification Factor, Mu	20

3.55.8 ACCEPTANCE TEST LIMITS

3.55.9 Table 3-92 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/189B dated 23 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Characteristics, unless otherwise indicated.

3.55.10 APPLICATION.

3.55.11 Figure 3-343 shows the permissible operating area for JAN-6111 as defined by the ratings in MIL-E-1/189B dated 23 August 1955. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

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* No test of operation at this rating exists in the specification.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current.

TABLE 3-92. ACCEPTANCE TEST LIMITS OF JAN-6111

PROPERTY		MEASUREMENT CONDITIONS	LIMITS INITIAL MIN	LIMITS INITIAL MAX	LIMITS LIFE TEST MIN	LIMITS LIFE TEST MAX	UNITS
Heater Current	If		280	320	276	328	mA
Transconductance (1)	Sm		4100	5900	---	---	umhos
Change in individuals	$\Delta\frac{Sm}{t}$		---	---	---	20	%
Transconductance (2)	$\Delta\frac{Sm}{Ef}$		---	15	---	.5	%
Amplification Factor	Mu		17	23	---	---	%
Plate Current (1)	Ib		6.0	11.0	---	---	mAdc
Plate Current (2)	Ib	Ec = -9.0Vdc	---	100	---	---	uAdc
Plate Current (1) Difference between sections	Ib	Rk = 0 ohms	---	2.0	---	---	mAdc
Pulse Emission	Is	Ef = 6.0 V; e pulse =50V tp =25u sec; prr= 200 pps	200	---	---	---	ma
Capacitance (No shield)							
Cgp/section		Ef = 0	1.2	1.8	---	---	uuf
Cin/section		Ef = 0	1.4	2.4	---	---	uuf
Cout section 1		Ef = 0	0.20	0.36	---	---	uuf
Cout section 2		Ef = 0	0.22	0.42	---	---	uuf
Cgg		Ef = 0	---	0.011	---	---	uuf
Cpp		Ef = 0	---	0.50	---	---	uuf
Grid Current	Ic	Rg = 1.0 Meg	0	-0.3	0	-0.9	uAdc
Grid Emission	Ic	Ef = 7.5Vdc Ec = -9.0Vdc Rk = 0; Rg = 1.0 Meg	0	-0.5	---	---	uAdc
Heater-Cathode	Ihk	Ehk = +100Vdc	---	5.0	---	10.0	uAdc
Leakage	Ihk	Ehk = -100 Vdc	---	-5.0	---	-10.0	uAdc
Insulation of	R(g-all)	g-all: Eg = -100	100	---	50	---	Meg
Electrodes	R(p-all)	Vdc; p-all: Ep= -300 Vdc	100	---	50	---	Meg

3.55.12 Table 3-93 lists general considerations for the application of this type. The numbers refer to applicable paragraphs of this Manual.

TABLE 3-93. APPLICATION PRECAUTIONS FOR JAN-6111

<u>Voltages</u>

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
- High, 3.1.8
- Low, 3.1.15
- AC Operation, 1.3.20, 3.1.10
- 28 Volt, 3.1.15

Control Grid Bias:
- Low, 1.3.4, 1.3.9, 3.1.3
- Cathode, 2.1.3, 3.1.12
- Fixed, 1.3.8, 2.1.3, 3.1.4

Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

<u>Resistance</u>

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3, 3.1.12

<u>Dissipation</u>

Plate, 2.1, 3.1.5

<u>Current</u>

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents, in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.37

<u>Temperature</u>

Bulb and Environmental, 3.1.5

<u>Miscellaneous</u>

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 3.1.13

3.55.13 In addition to the considerations noted above, JAN-6111, as reflected in Specification MIL-E-1/189B, provides additional assurance of pulse operation, initially at least, by an acceptance test requirement of 300 ma minimum peak plate current with pulse voltage applied.

3.55.14 VARIABILITY OF JAN-6111 CHARACTERISTICS.

3.55.15 The following charts show the variation which must be expected among individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.55.16 Figure 3-344 presents the limit behavior of static plate characteristics for JAN-6111 as defined by MIL-E-1/189B dated 23 August 1955.

3.55.17 Figure 3-345 presents the limit behavior of transfer data for JAN-6111 as defined by MIL-E-1/189B dated 23 August 1955.

3.55.18 DESIGN CENTER CHARACTERISTICS.

3.55.19 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.55.20 Figure 3-346 presents the static plate characteristics of JAN-6111.

3.55.21 Figures 3-347 and 3-348 present the typical plate transfer data for JAN-6111.

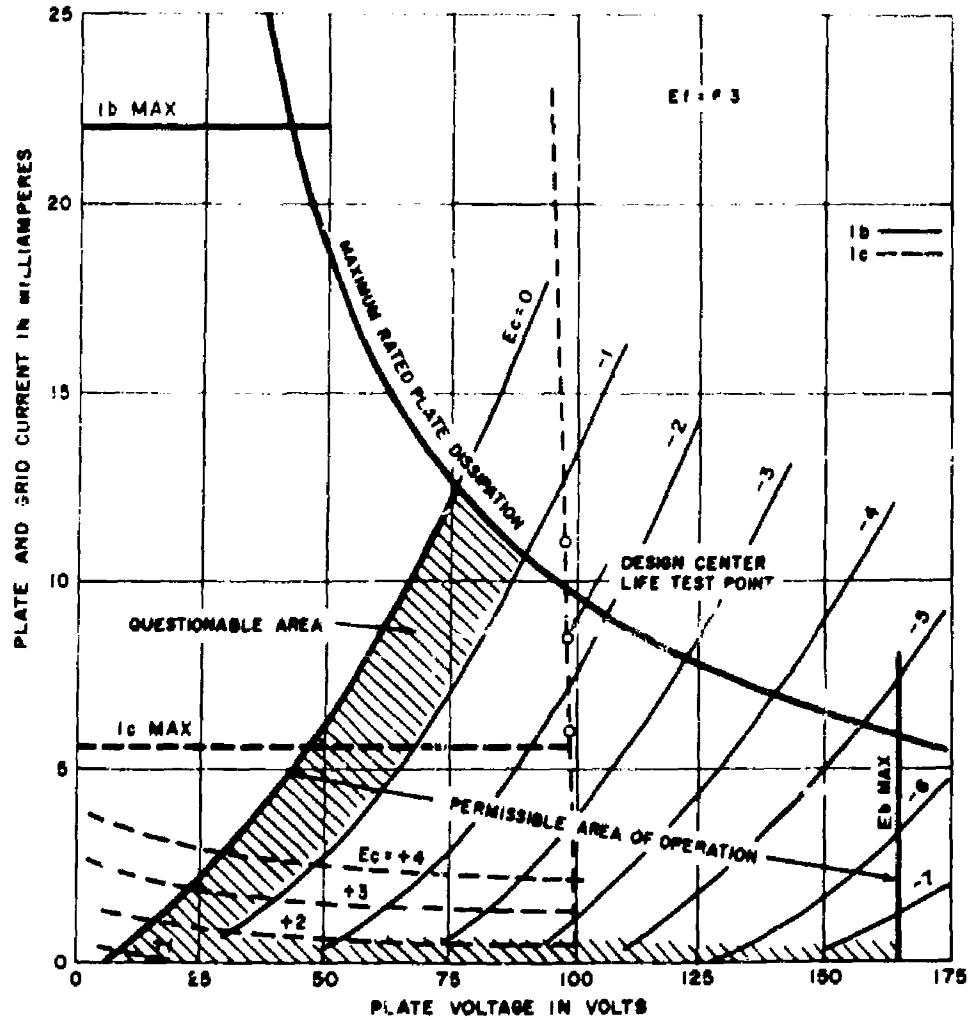


Figure 3-343. Typical Characteristics of Tube Type JAN-6111
Permissible Area of Operation

origi-

AN-

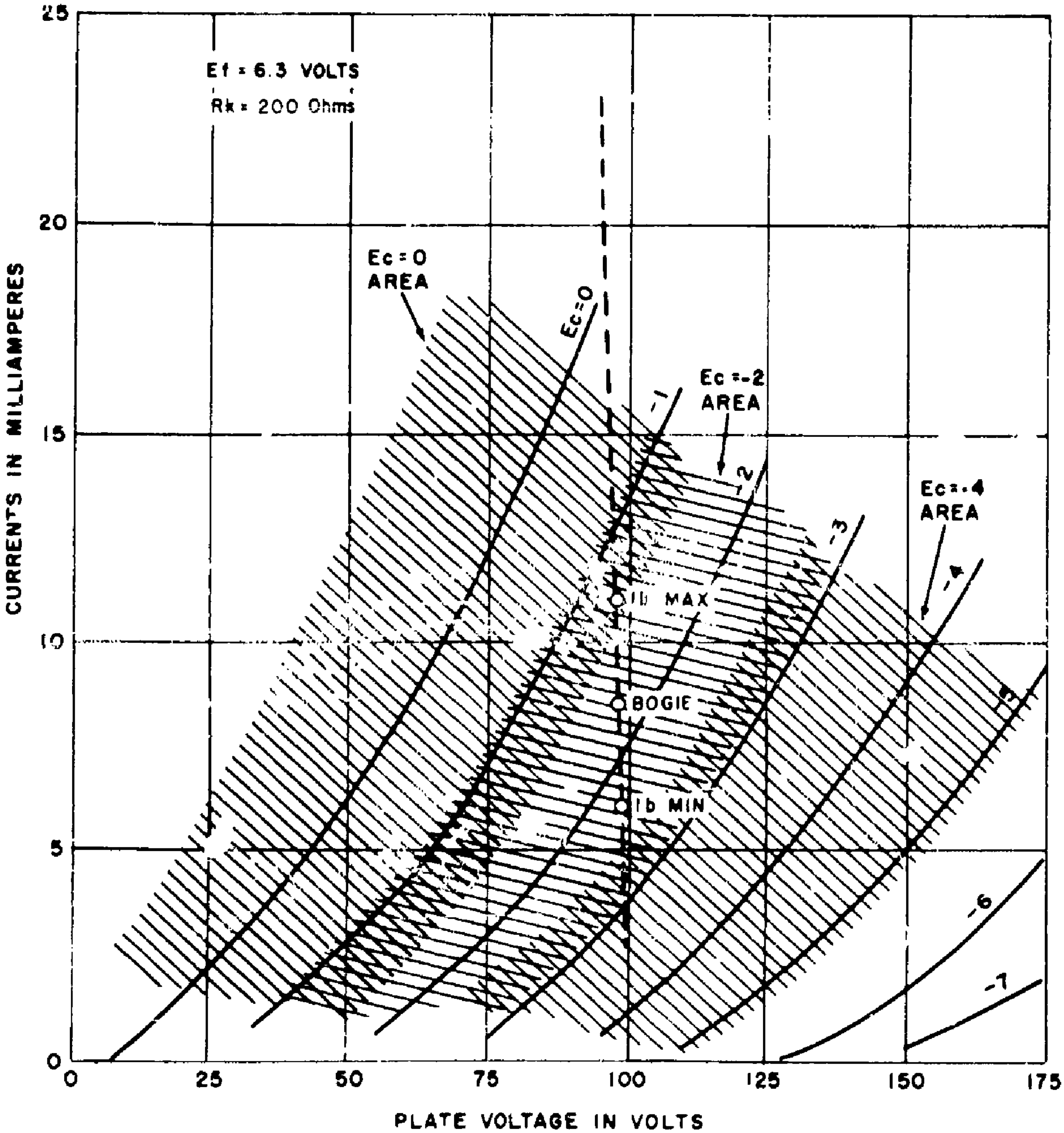


Figure 3-344. Limit Behavior of Tube Type JAN-6111 Static Plate Data; Variability of Ib

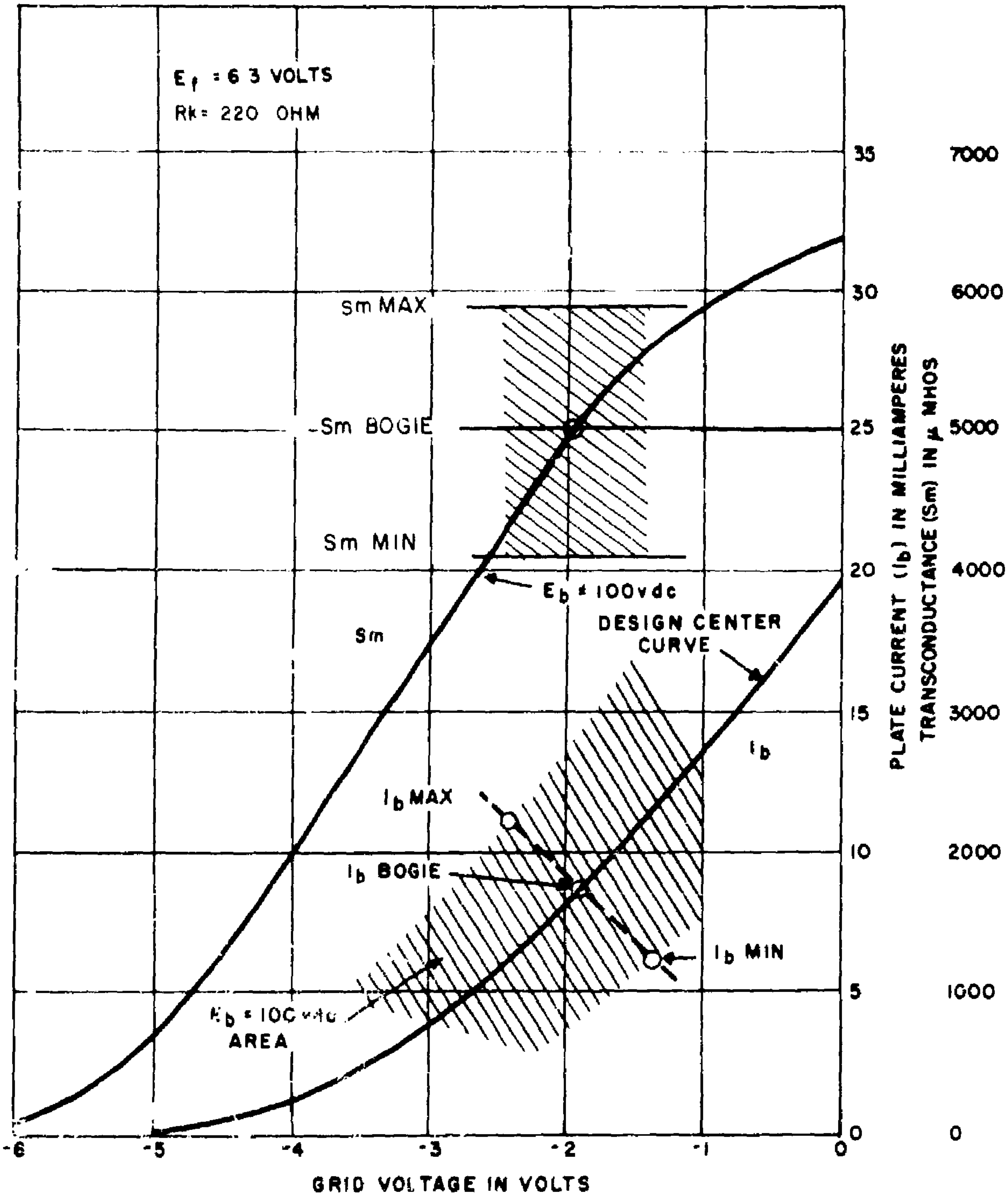


Figure 3-345. Limit Behavior of Tube Type JAN-6111; Variability of Ib and Sm

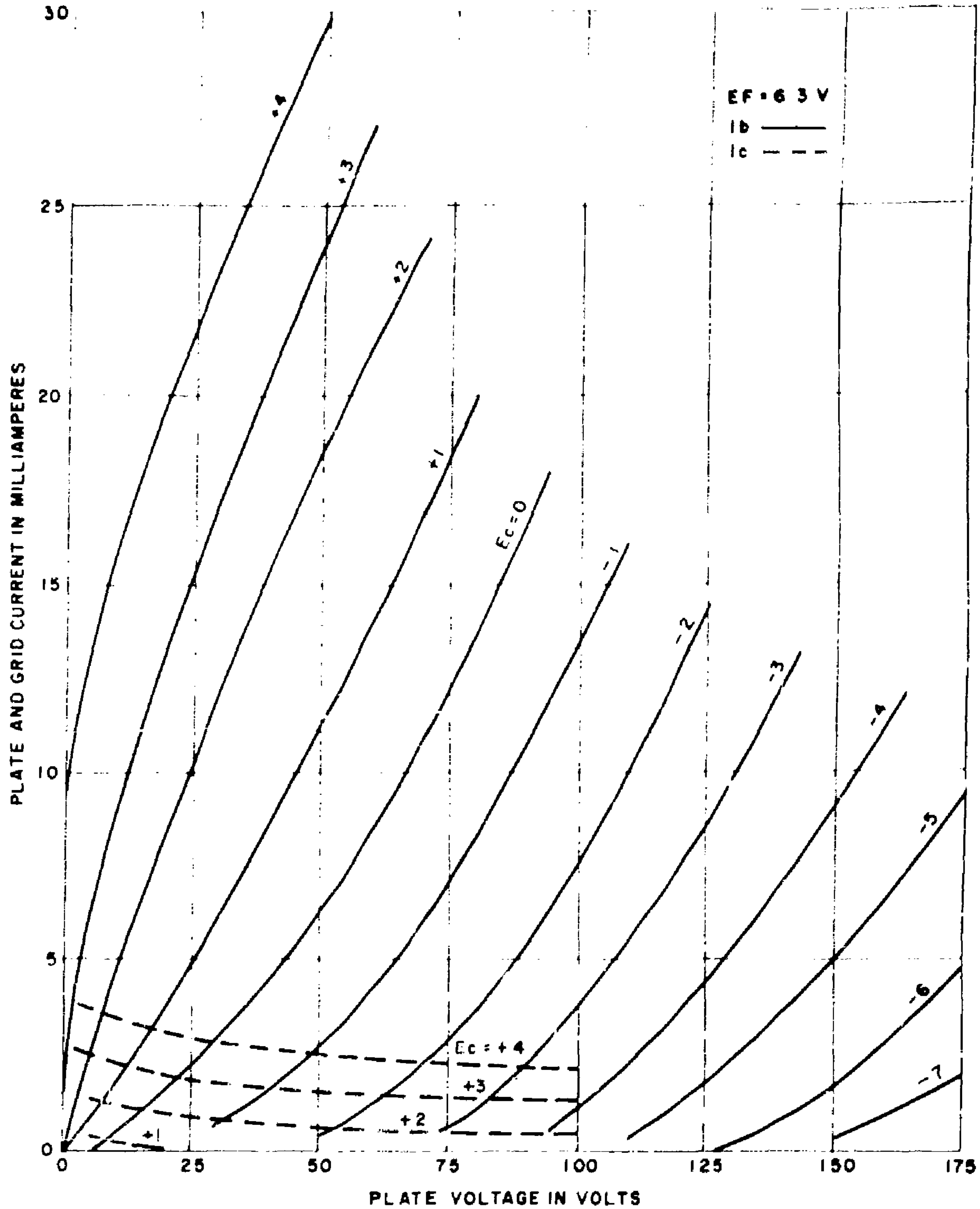


Figure 3-346. Typical Static Plate Characteristics of Tube Type JAN-6111

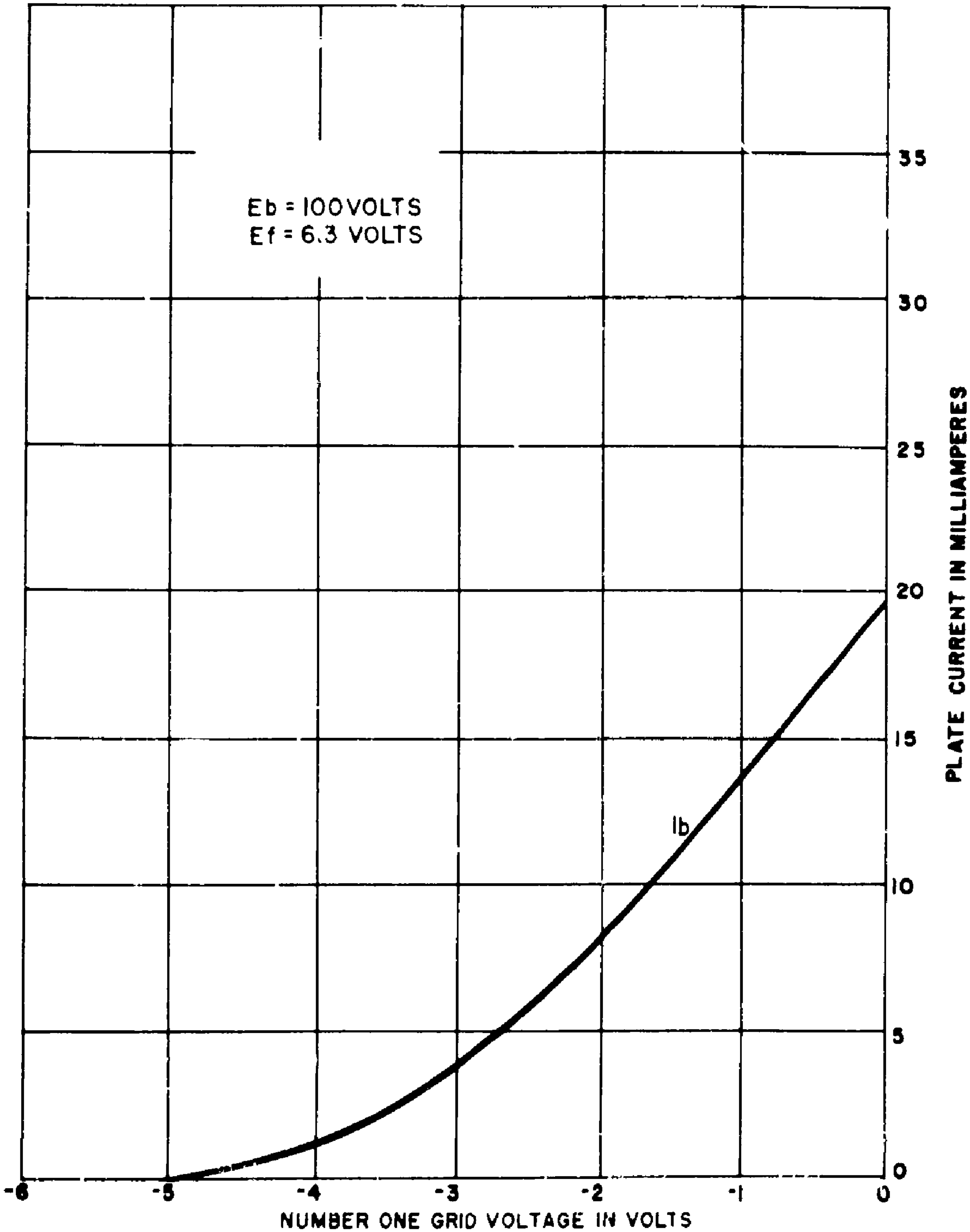


Figure 3-347. Typical Plate Transfer Characteristic of Tube Type JAN-6111

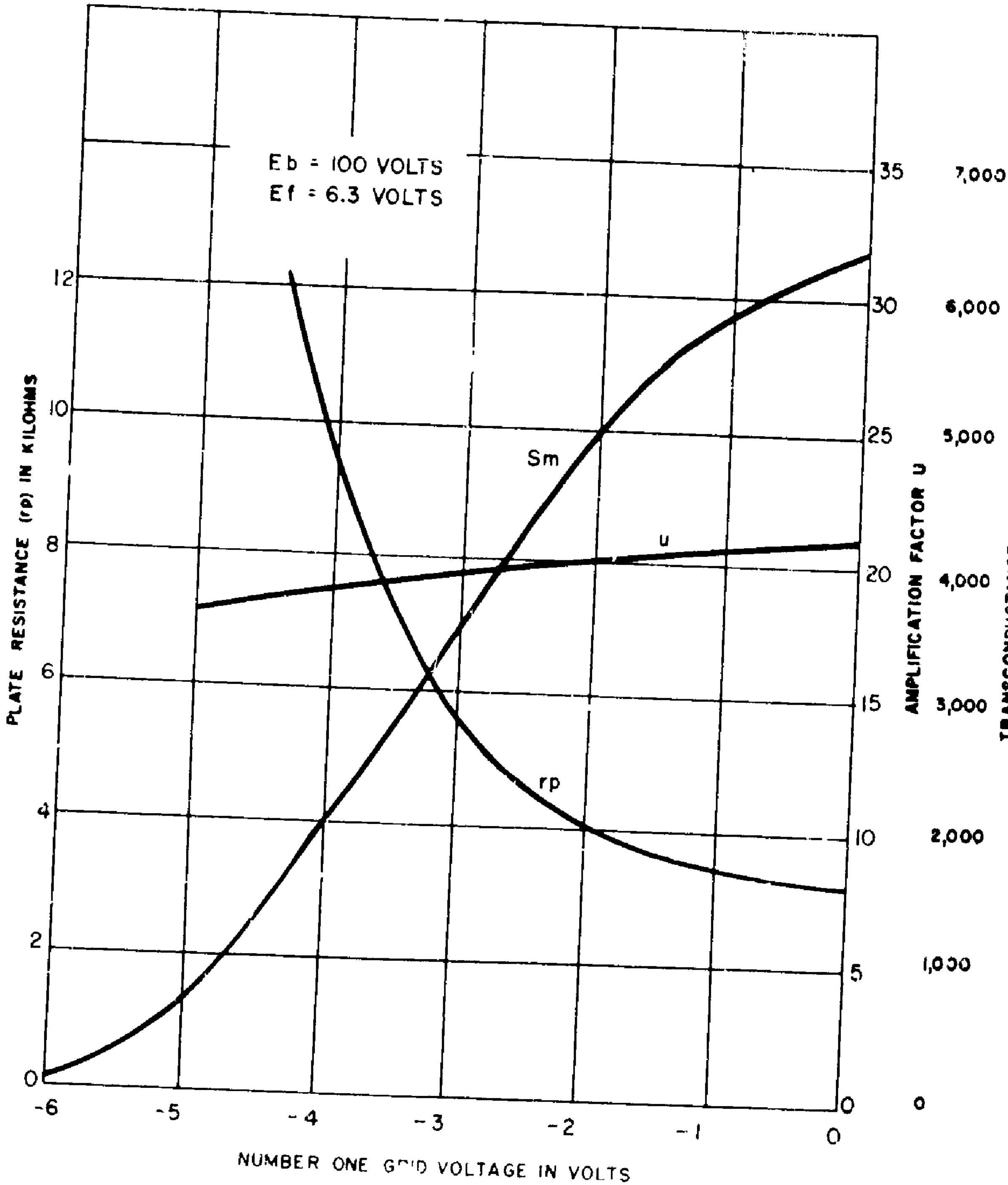


Figure 3-348. Typical Sm, Rp and u Characteristics of Tube Type JAN-6111

SECTION 56

TUBE TYPE JAN-6112

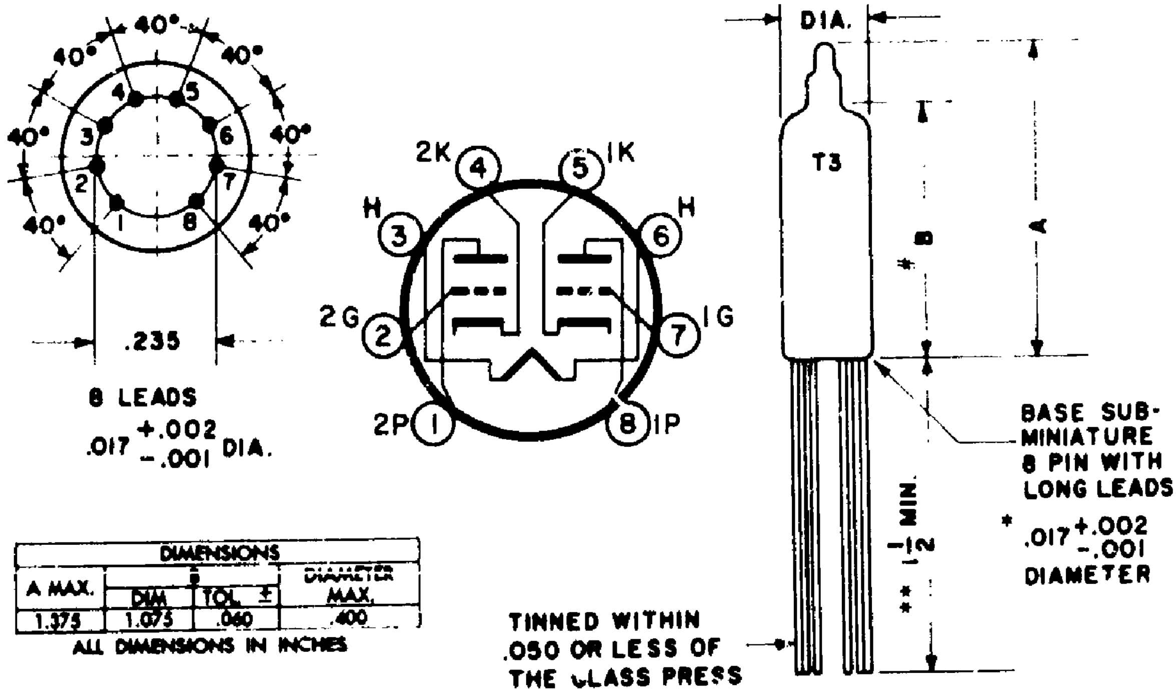
3.56 DESCRIPTION.

3.56.1 The JAN-6112 1/ is an 8-lead, button- base subminiature twin triode having a design center Mu of 70. The JAN-6112 has given satisfactory service in audio-frequency amplifier and phase inverter service.

3.56.2 ELECTRICAL. Electrical characteristics are as follows:

Heater Voltage . . . . 6.3 V
Heater Current, Design Center . . . . 300 mA
Cathode . . . . Coated Unipotential

3.56.3 MOUNTING. Not specified.



DIMENSIONS			
A MAX.	B		DIAMETER MAX.
	DIM	TOL. ±	
1.375	1.075	.060	.400

ALL DIMENSIONS IN INCHES

MEASURE FROM BASE SEAT TO BULB TOP-LINE AS DETERMINED BY RING GAGE OF .210 ± .001.

* LEAD DIAMETER TOLERANCE SHALL GOVERN BETWEEN .050 FROM THE GLASS TO .250 FROM THE GLASS

** ALTERNATIVE LEAD LENGTH SHALL BE .200 ± .015 WHEN CUT LEADS ARE REQUIRED BY PROCUREMENT CONTRACT OR TSS. CUT LEADS SHALL BE ESSENTIALLY SQUARE CUT AND THE MAXIMUM BURR SHALL BE .003 INCREASE OVER THE ACTUAL LEAD DIAMETER.

Figure 3-349. Outline Drawing and Base Diagram of Tube Type JAN-6112

1/ The values and specification comments presented in this section are related to MIL-E-1/190B dated 5 August 1955.

3.56.4 RATINGS, ABSOLUTE SYSTEM.

3.56.5 The absolute system ratings are as follows:

Heater Voltage	6.3 ± 0.3 V
Plate Voltage	165 Vdc
Reference MIL-E-1C Section 6.5.1.1 Plate Voltage	
Grid Voltage, Maximum	0 Vdc
Grid Voltage, Minimum	-55 Vdc
Heater-Cathode Voltage	200 v
Grid Series Resistance	1.1 Meg
** Plate Current	3.3 mAdc
Plate Dissipation	.10 W
Bulb Temperature	+220°C
Altitude Rating	60,000 ft

3.56.6 TEST CONDITIONS AND DESIGN CENTER CHARACTERISTICS.

3.56.7 Test conditions and design center characteristics are as follows:

Heater Voltage, Ef	6.3 V
Plate Voltage, Eb	100 Vdc
Heater-Cathode Voltage, Ehk	0 v
Cathode Resistance, Rk	1500 ohms
Heater Current, If	300 mA
Transconductance, Sm	1800 umhos
Amplification Factor, Mu	70

3.56.8 ACCEPTANCE TEST LIMITS.

3.56.9 Table 3-94 summarizes certain salient requirements set forth by the specification for which acceptance test limits exist. This table is in no wise intended to include all the properties for which measurement limits are provided. Specification MIL-E-1/190 B dated 5 August 1955 should be referenced to determine further assurance of satisfactory operation in any specific application. Measurement conditions are the same as stated under Test Conditions and Design Center Charactertistics, unless otherwise indicated.

3.56.10 APPLICATION.

3.56.11 Figure 3-350 shows the permissible operating area for JAN-6112 as defined by the ratings in MIL-E-1/190B dated 5 August 1955. A discussion of the permissible operating area for triodes may be found in paragraph 3.1.2.

** Difficulty may be encountered if this tube is operated for long periods of time with very small values of cathode current. No specification assurance of life exists under conditions of cathode current approaching the maximum.

TABLE 3-94. ACCEPTANCE TEST LIMITS OF JAN-6112

PROPERTY		MEASUREMENT CONDITIONS	LIMITS				UNITS
			INITIAL		LIFE TEST		
			MIN	MAX	MIN	MAX	
Heater Current	If		280	320	276	328	mA
Transconductance (1)	Sm		1500	2100	---	---	umhos
Change in individuals	$\Delta \frac{Sm}{t}$		---	---	---	25	%
Transconductance (2)	$\Delta \frac{Sm}{Ef}$		---	15	---	15	%
Amplification Factor	Mu		60	80	---	---	---
AC Amplification	Ep	Ebb=100Vdc; Ecc = 0; Esig = 0.2 Vac; Rk = 0	8.0	---	---	---	Vac
Plate Current (1)	Ib		0.50	1.10	---	---	mAdc
Plate Current (2)	Ib	Ec = -2.8 Vdc; Rk = 0	---	50	---	---	uAdc
Capacitance	Cgp	Ef = 0	0.8	1.20	---	---	uuf
(without shield	Cin	Ef = 0	1.30	2.10	---	---	uuf
Section 1 -	Cout	Ef = 0	0.16	0.30	---	---	uuf
Section 2 -	Cout	Ef = 0	0.21	0.35	---	---	uuf
	Cgg	Ef = 0	---	0.014	---	---	uuf
	Cpp	Ef = 0	---	0.80	---	---	uuf
Grid Current	Ic	Eb=150; Ec = 0 Rk = 820; Rg = 1.0 Meg	0	-0.3	0	-0.9	uAdc
Grid Emission	Ic	Ef = 7.5 V; Ec = -4.0 Vdc Eb = 150 Vdc; Rk= 0; Rg = 1.0 Meg	0	-0.5	---	---	uAdc
Heater-Cathode	Ihk	Ehk = +100Vdc	---	5.0	---	10	uAdc
Leakage	Ihk	Ehk = -100Vdc	---	-5.0	---	-10	uAdc
Insulation of	R(g-all)	Eg-all = -100Vdc	100	---	50	---	Meg
Electrodes	R(p-all)	Ep-all -300 Vdc	100	---	50	---	Meg

3.56.12 Table 3-95 lists general considerations for the application of this type. The numbers refer to the applicable paragraphs of this Manual.

TABLE 3-95. APPLICATION PRECAUTIONS FOR JAN-6112

Voltages

Heater, 1.3.8, 1.3.17, 1.3.22, 1.3.27, 1.3.37, 1.3.51, 1.3.55, 3.1.11
Heater-Cathode, 1.3.30
Plate:
  High, 3.1.8
  Low, 3.1.15
  AC Operation, 1.3.20, 3.1.10
  28 Volt, 3.1.15
Control Grid Bias:
  Low, 1.3.4, 1.3.9, 3.1.3
  Cathode, 2.1.3, 3.1.12
  Fixed, 1.3.7, 2.1.3, 3.1.4
Positive Grid Region, 3.1.14
Contact Potential, 1.3.4, 3.1.4, 3.1.15

Resistance

Control Grid Series, 1.3.9, 1.3.19, 1.3.22, 1.3.23, 3.1.13
Cathode Interface, 1.3.50, 3.1.9
Cathode, 1.3.33, 1.3.34, 1.3.35, 2.1.3 3.1.12

Dissipation

Plate, 2.1, 3.1.5

Current

Control Grid, 1.3.4, 1.3.9, 1.3.23, 3.1.3
Plate, Low, 1.3.50, 3.1.4, 3.1.9
Interelectrode Leakage, 1.3.14
Gas, 1.3.9, 3.1.3
Control Grid Emission, 1.3.18
Cross Currents in Multistructure Tubes, 1.3.28
Cathode, Thermionic Instability, 1.3.27

Temperature

Bulb and Environmental, 3.1.5

Miscellaneous

Pulse Operation, 3.1.14
Shielding, 3.1.5
Intermittent Operation, 3.1.9
Electron Coupling Effects, 1.3.44
Microphonics, 1.3.56, 1.3.16

3.56.13 In addition to the considerations noted above, JAN-6112 as reflected in Specification MIL-E-1/190B provides limited assurance of operation in the low plate-voltage, low plate-current region by an acceptance test for ac amplification using grid leak bias; 100 volt plate supply and 0.5 megohm plate load resistance. In this region any operation other than that described above must be questioned, since most tube properties are not assured in the low-current and zero-bias regions.

3.56.14 VARIABILITY OF CHARACTERISTICS.

3.56.15 The following charts show the variation which must be expected between individual tubes. The variability boundaries were determined from the acceptance limits given on the specification.

3.56.16 Figure 3-351 presents the limit behavior of static plate characteristics for JAN-6112 as defined by MIL-E-1/190B dated 5 August 1955

3.56.17 Figure 3-352 presents the limit behavior of transfer data for JAN-6112 as defined by MIL-E-1/190B dated 5 August 1955.

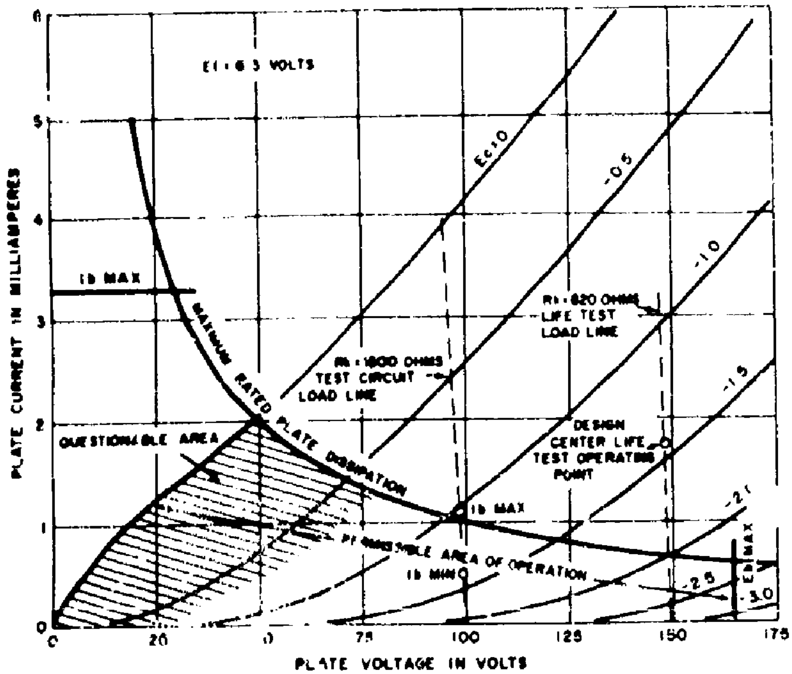


Figure 3-350. Typical Static Plate Characteristics of Tube Type JAN-6112: Permissible Area of Operation

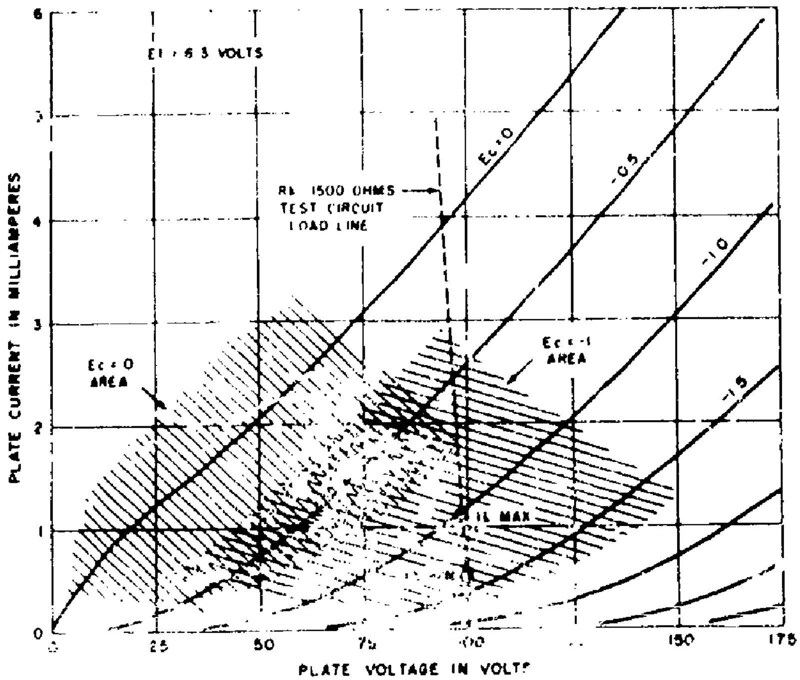


Figure 3-351. Limit Behavior of Tube Type JAN-6112 Static Plate Data: Variability of Ib

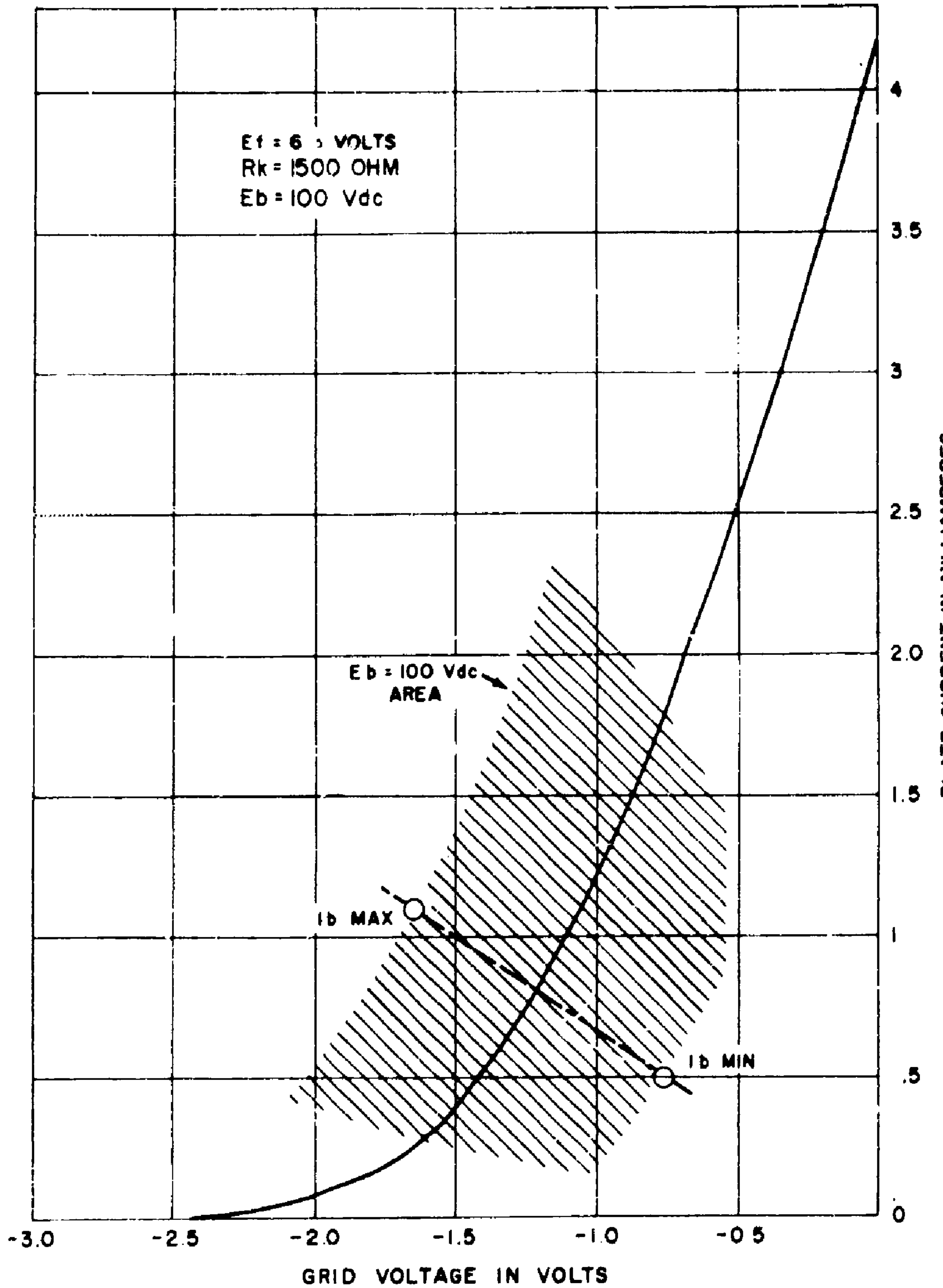


Figure 3-352. Limit Behavior of Tube Type JAN-6112 Transfer Data; Variability of Ib

3.56.18 DESIGN CENTER CHARACTERISTICS.

3.56.19 These typical curves have been obtained from data published by the original RETMA registrant of this type.

3.56.20 Figure 3-353 presents the static plate characteristics of JAN-6112.

3.56.21 Figure 3-354 and 355 present the typical plate transfer data for JAN-6112, and Rp, Sm and u Characteristics.

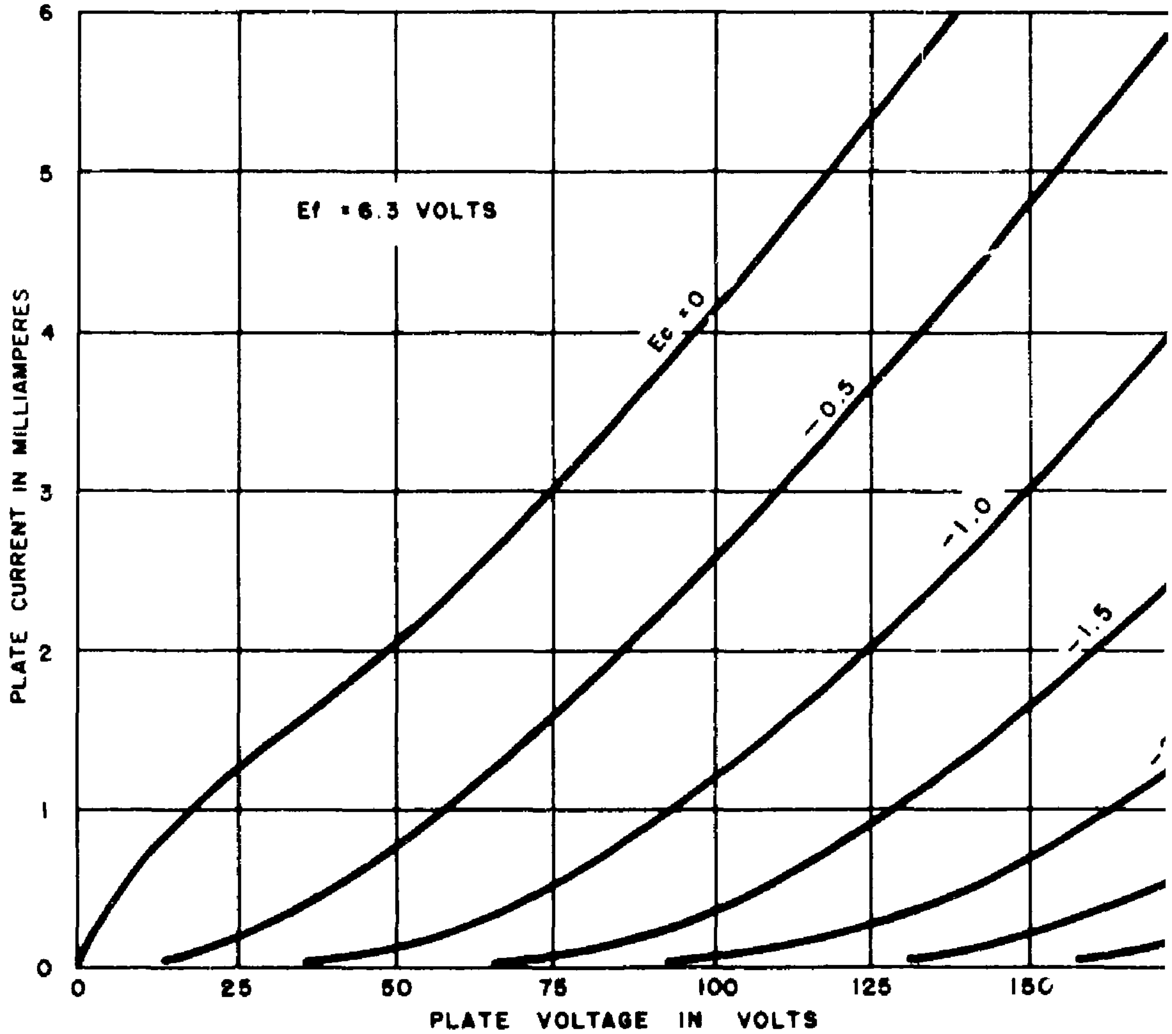


Figure 3-353. Typical Static Plate Characteristics of Tube Type JAN-6112

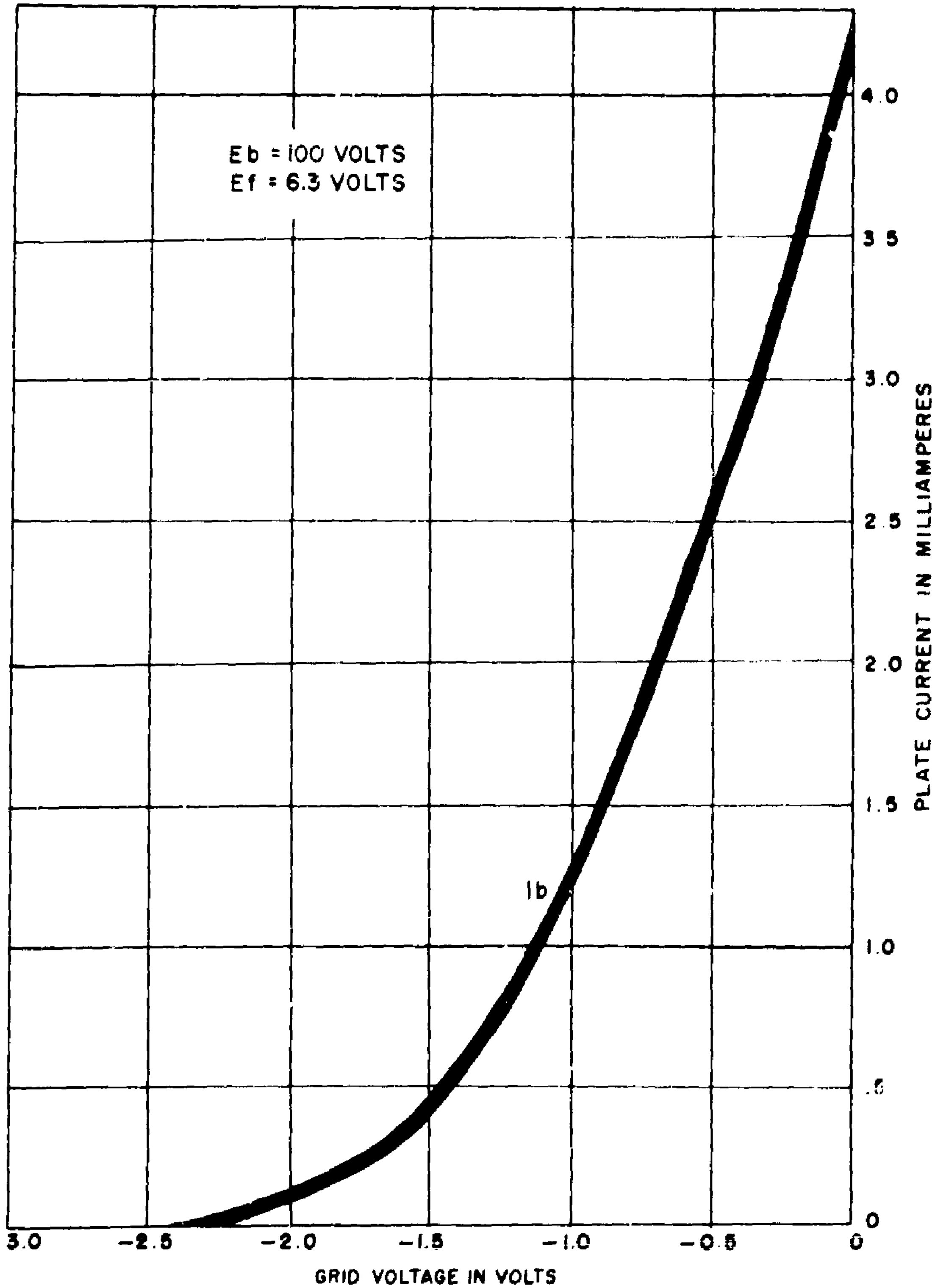


Figure 3-354. Typical Plate Transfer Characteristic of Tube Type JAN-6112

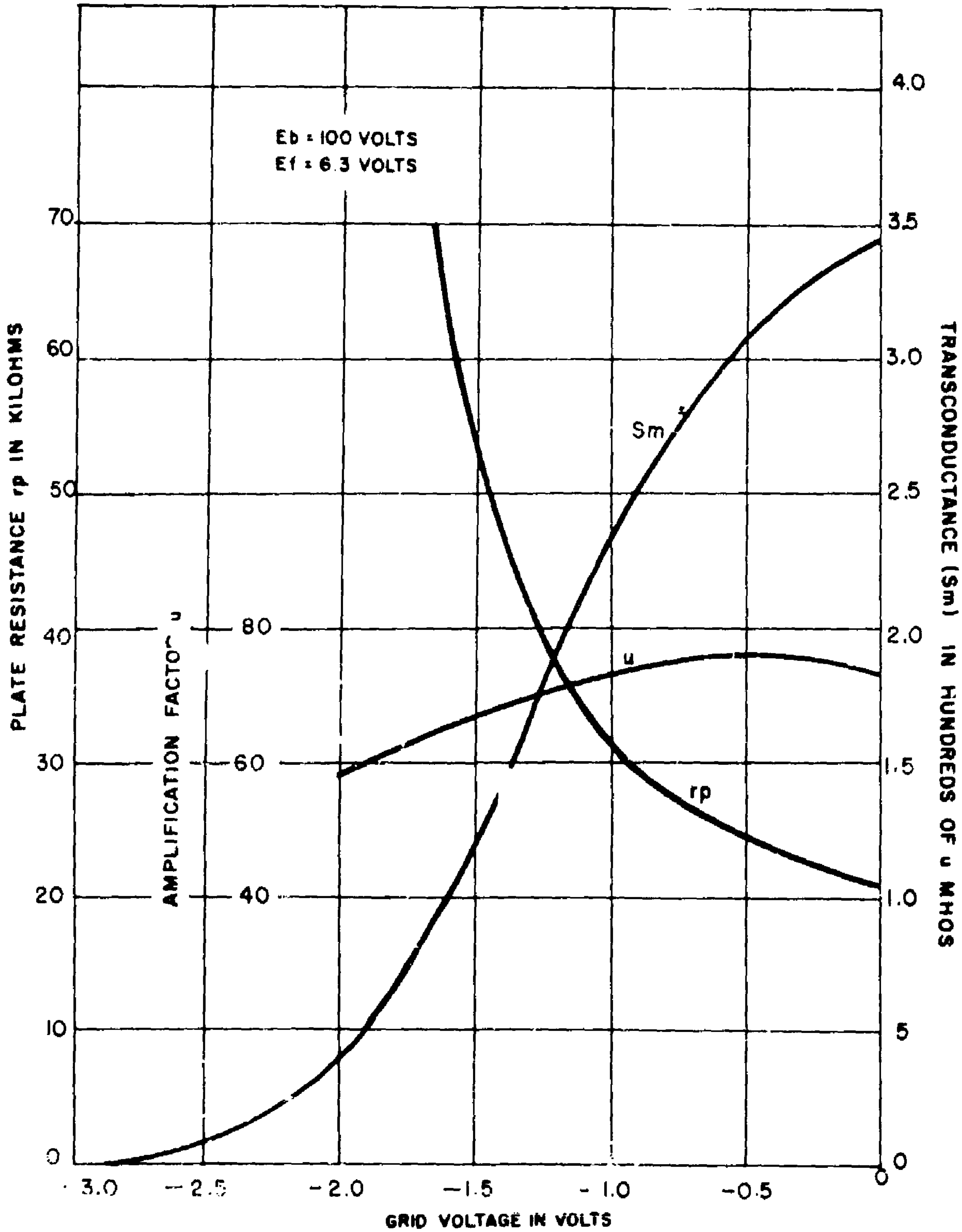


Figure 3-355. Typical Sm, Rp and u Characteristics of JAN-6112

PART IV

PROPERTY BEHAVIOR

4. COMPONENT STABILITY.

4.01 LIFE TEST DISTRIBUTION CURVES. Initial interchangeability alone is not sufficient to guarantee a satisfactory equipment design. The equipment designer must take into account not only the initial variability of tube properties but also the stability of tube characteristics under the anticipated environmental stresses. It is not sufficient to design an equipment which will function properly the first few hours after it has been installed. Some equipments are called upon to give trouble-free operation for hundreds and even thousands of hours, as in the case of fixed-station installations. Consequently any design, to be reliable, must take into account both the variability and the stability of its integral components, throughout their operation life. The Life Test distribution curves presented in this part, for tube types included in Part III, show the initial distributions of essential properties and the observed change with life of the average and spread of these distributions.

4.02 The empirical nature of these distributions sets them apart from the assurances calculable from the specification. The curves represent only an estimate of the product description for a certain procurement period. The equipment designer should therefore view each curve as typical of the behavior of a group of tubes. The recurrence of these patterns in future procurement can be predicted only to the extent indicated by the specification limits shown on the individual drawing and by knowledge of the natural processes at work -- which, for example, cause a decay rather than an increase in average value, etc.

4.03 MEASUREMENT AND AGING CONDITIONS. The measurement and aging conditions are those set forth in the applicable specification. Estimation of property behavior under environmental and operating stresses other than those specified should be approached with extreme caution.

4.04 DISTRIBUTION SAMPLING. Each distribution curve or histogram represents data from a small sample of tubes manufactured during the period indicated on each chart. This sample may be as small as three tubes per lot or as large as 20 tubes per lot, depending upon the tube type and its production rate. Many lots may be produced each year or very few as the case may be. The data presented here was, in the main, drawn from randomly selected lots from each manufacturer of the tube type, uniformly chosen to cover his period of manufacture during the recent calendar year. The total sample size and the number of manufacturers contributing data are indicated for each plot.

4.05 VERTICAL SCALE OF PLOTS. The vertical scale of the plots was deliberately omitted, since the sample size does not warrant strict interpretation. The general shape of the curves is presented solely to serve as an estimator of what might be encountered in actual practice.

SECTION 1

PROPERTY BEHAVIOR FOR JAN-1AD4

4.1 DISTRIBUTION CURVES.

4.1.1 The distribution curves below are based upon data from 190 tubes life-tested by one manufacturer of the type during the period of July 1953 through November 1955. The specification limits shown are taken from MIL-E-1/20A dated July 9, 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

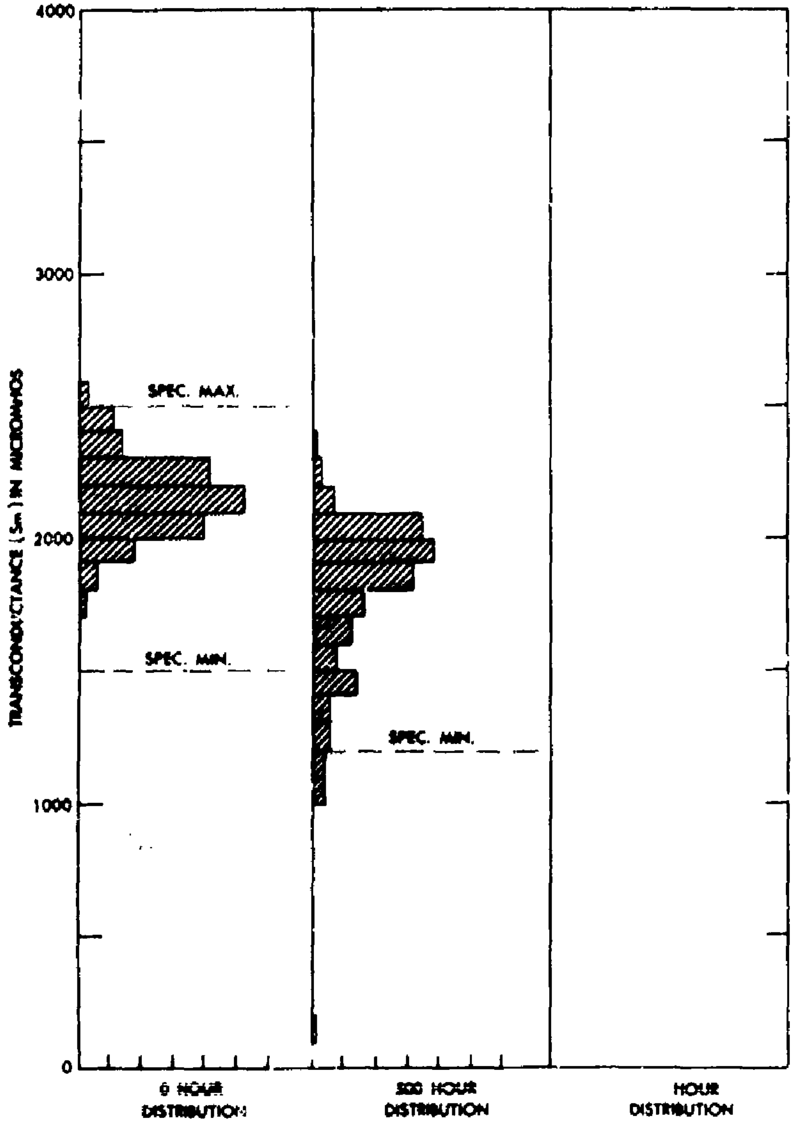


Figure 4-1. Distribution of Transconductance for JAN-1AD4

4.1.2 The distribution curves below are based upon data from 190 tubes life-tested by one manufacturer of the type during the period of July 1953 through November 1955. The specification limits shown are taken from MIL-E-1/20A dated July 9, 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

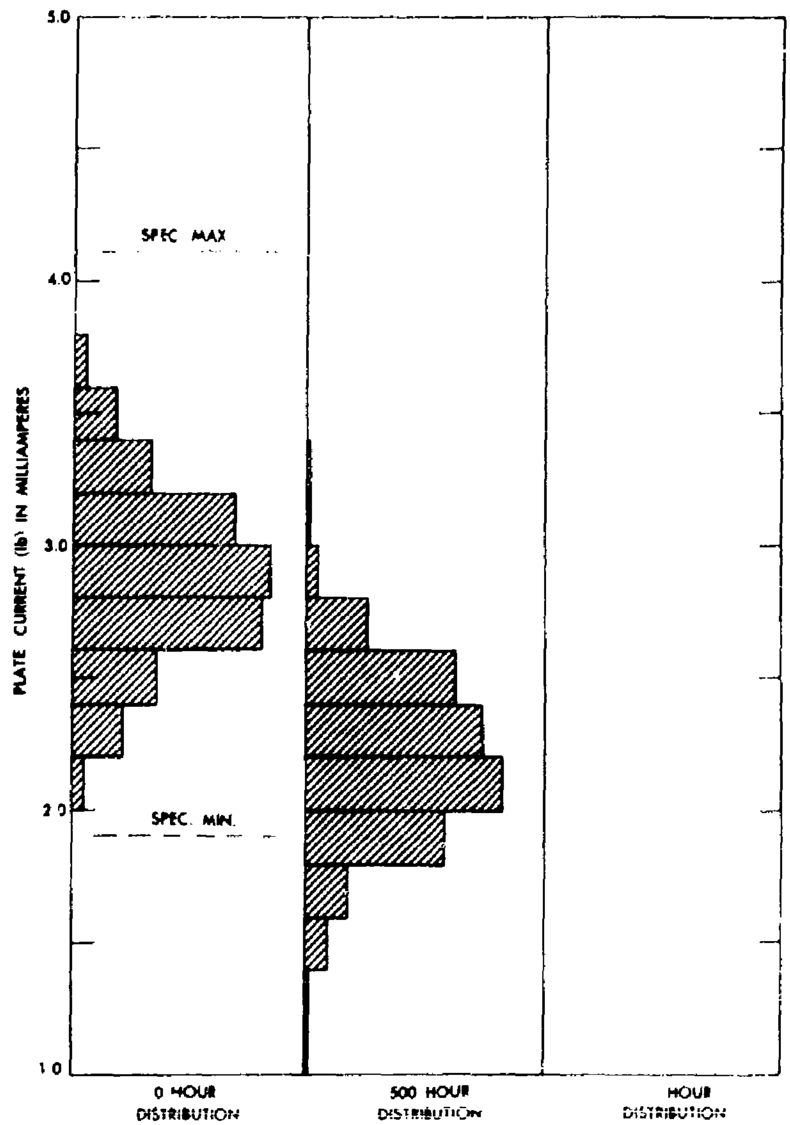


Figure 4-2. Distribution of Plate Current for JAN-1AD4

4.2 DISTRIBUTION CURVES.

4.2.1 The distribution curves below are based upon 50 tubes (10 lots) life-tested 1 manufacturer of the type during the year 1955. The specification limits shown taken from MIL-E-1/33 dated 5 February 1953. Only data from lots accepted by specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

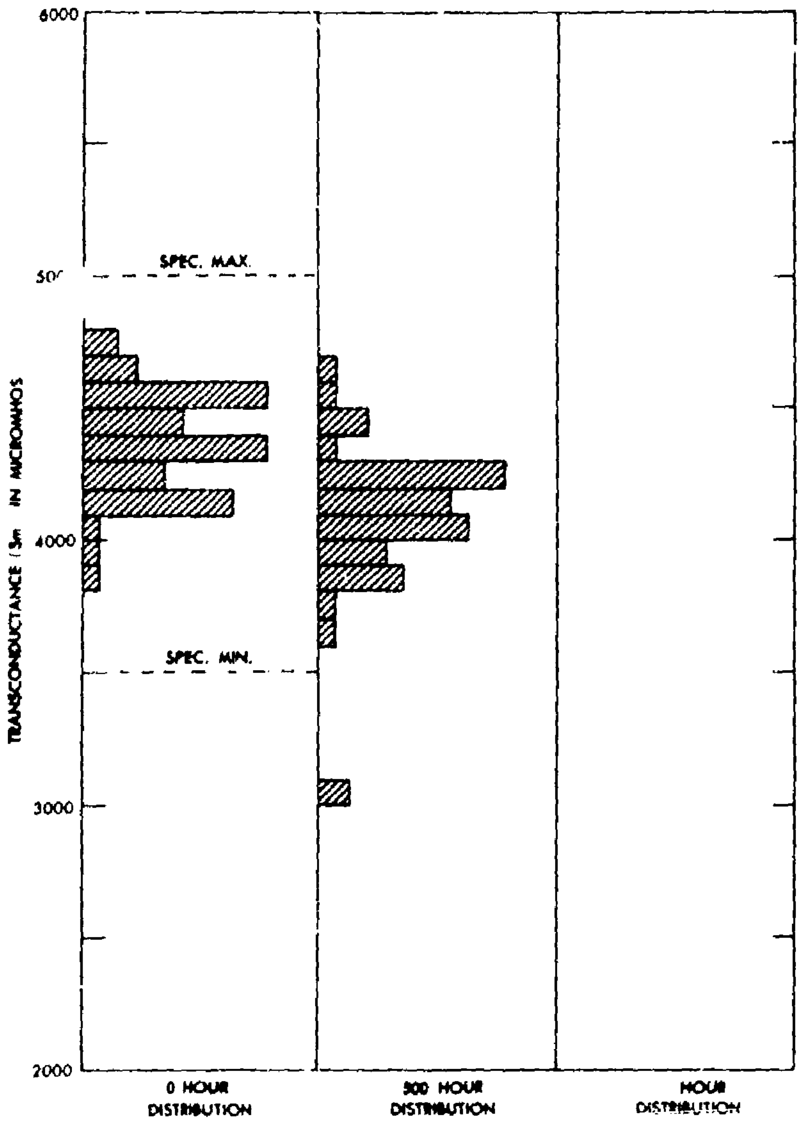


Figure 4-3. Distribution of 'ransconductance for JAN-3E30

4.2.2 The distribution curves below are based upon 50 tubes (10 lots) life-tested by 1 manufacturer of the type during the year 1955. The specification limits shown are taken from MIL-E-1/32 dated 5 February 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

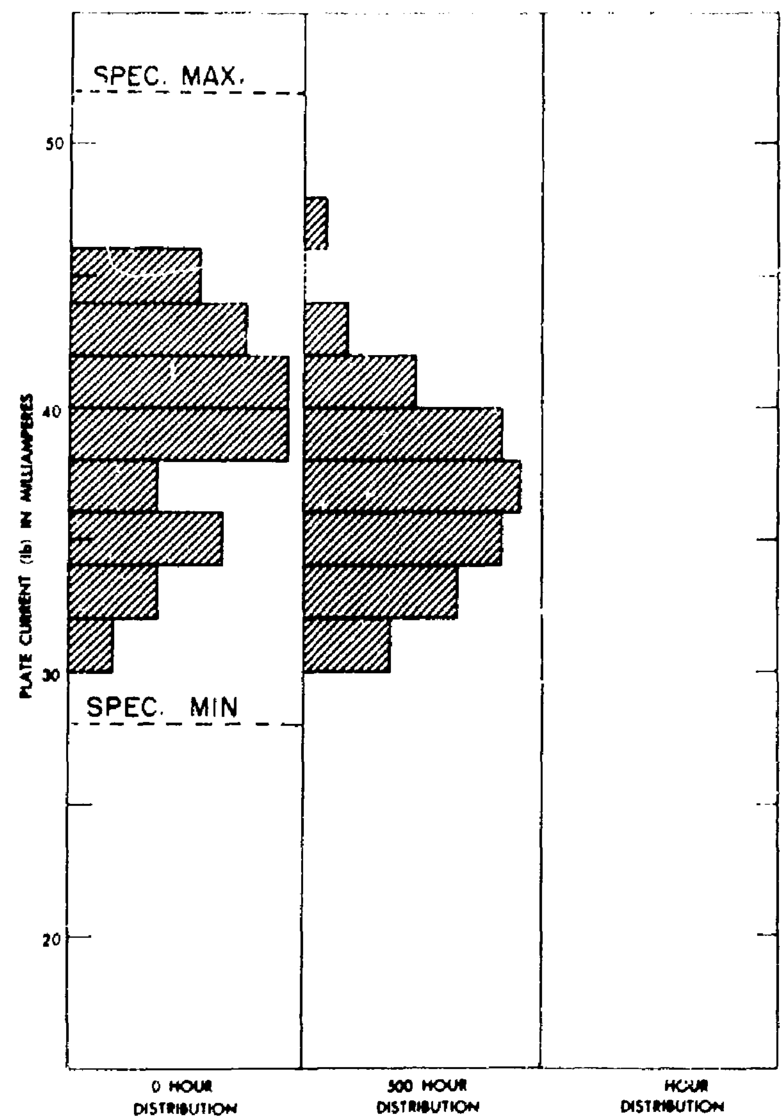


Figure 4-4. Distribution of Plate Current for JAN-2E30

4.2.3 The distribution curves below are based upon 50 tubes (10 lots) life-tested by 1 manufacturer of the type during the year 1955. The specification limits shown are taken from MIL-E-1/32 dated 5 February 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

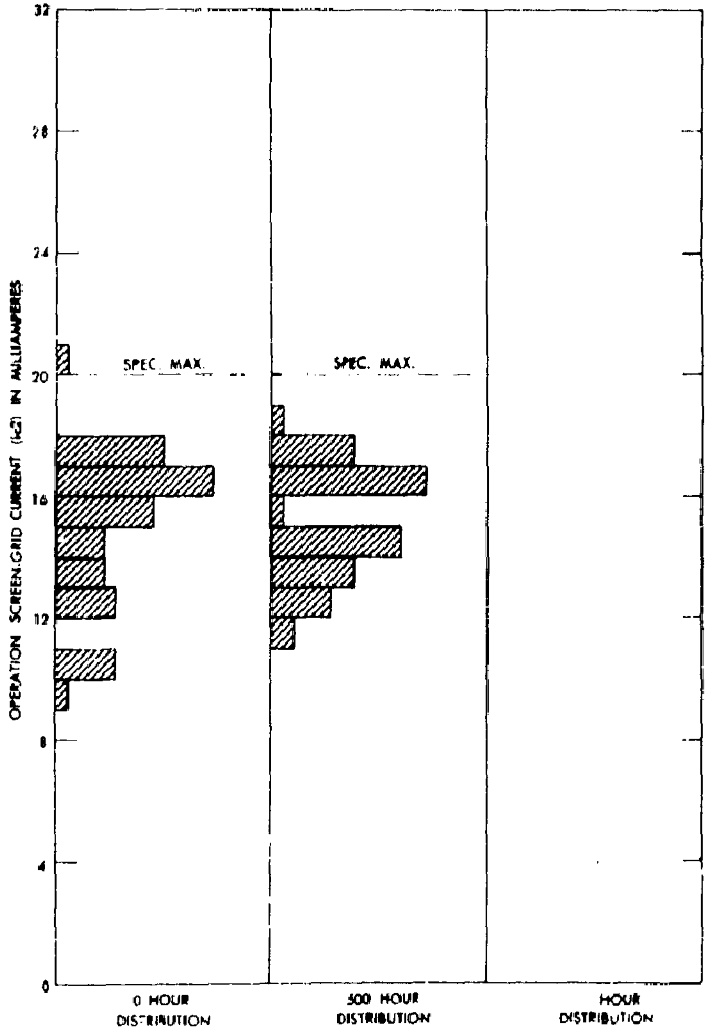


Figure 4-5. Distribution of Operation Screen Current for JAN-2E30

SECTION 3

PROPERTY BEHAVIOR FOR JAN-3A5

4.3 DISTRIBUTION CURVES.

4.3.1 The distribution curves below are based upon 110 tubes (22 lots) life-tested by one manufacturer of the type during the year 1955. The specification limits shown are taken from MIL-E-1/33A dated 14 January 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

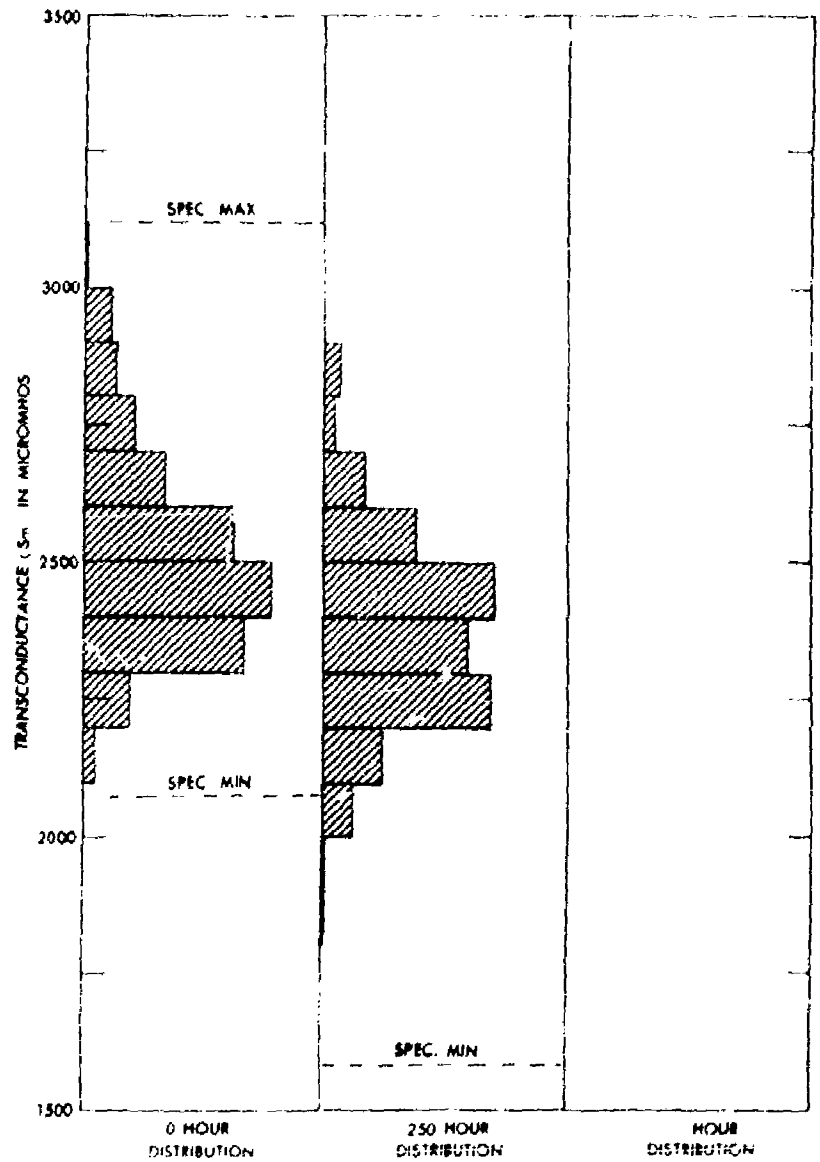


Figure 4-6. Distribution of Transconductance for JAN-3A5

4.3.2 The distribution curves below are based upon 110 tubes (22 lots) life-tested by one manufacturer of the type during the year 1955. The specification limits shown are taken from MIL-E-1/33A dated 14 January 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

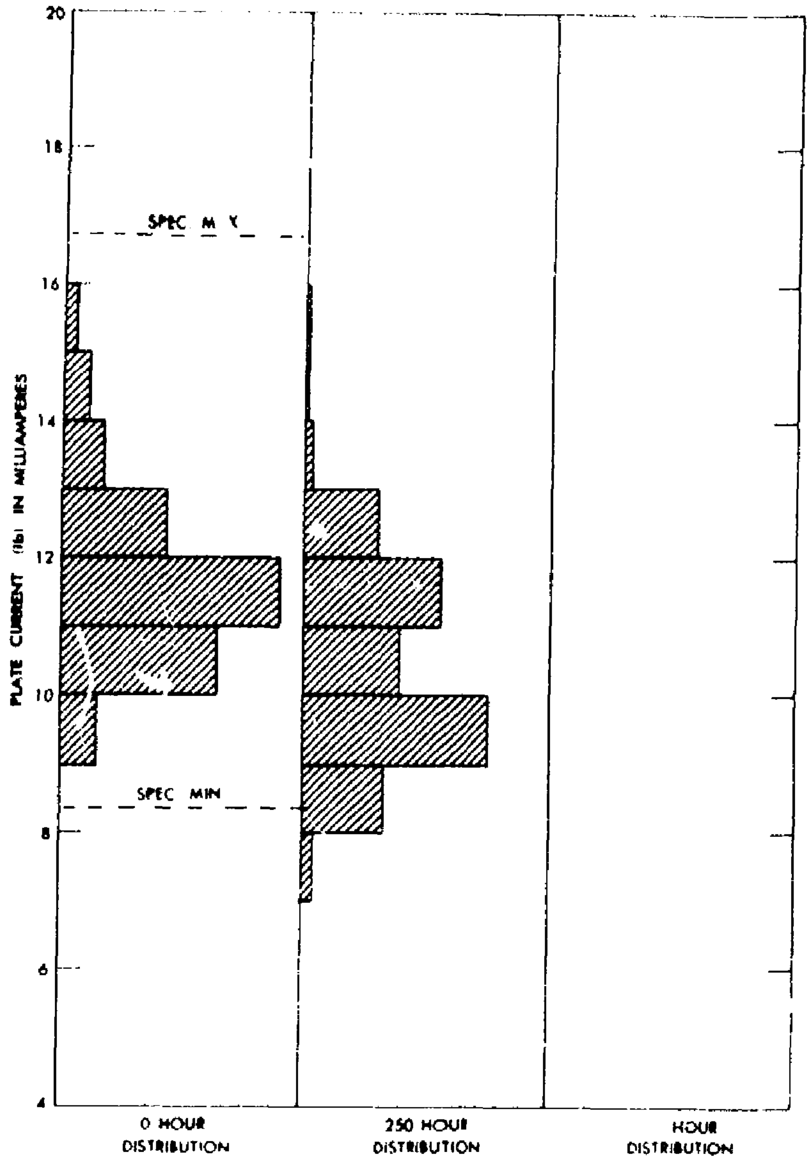


Figure 4-7. Distribution of Plate Current for JAN-3A5

4.4 DISTRIBUTIO.I CURVES.

4.4.1 The distribution curves below are based upon 30 tubes (6 lots) life-tested by one manufacturer of the type during the latter months of 1955. The specification limits shown are taken from MIL-E-1/34B dated 17 December 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

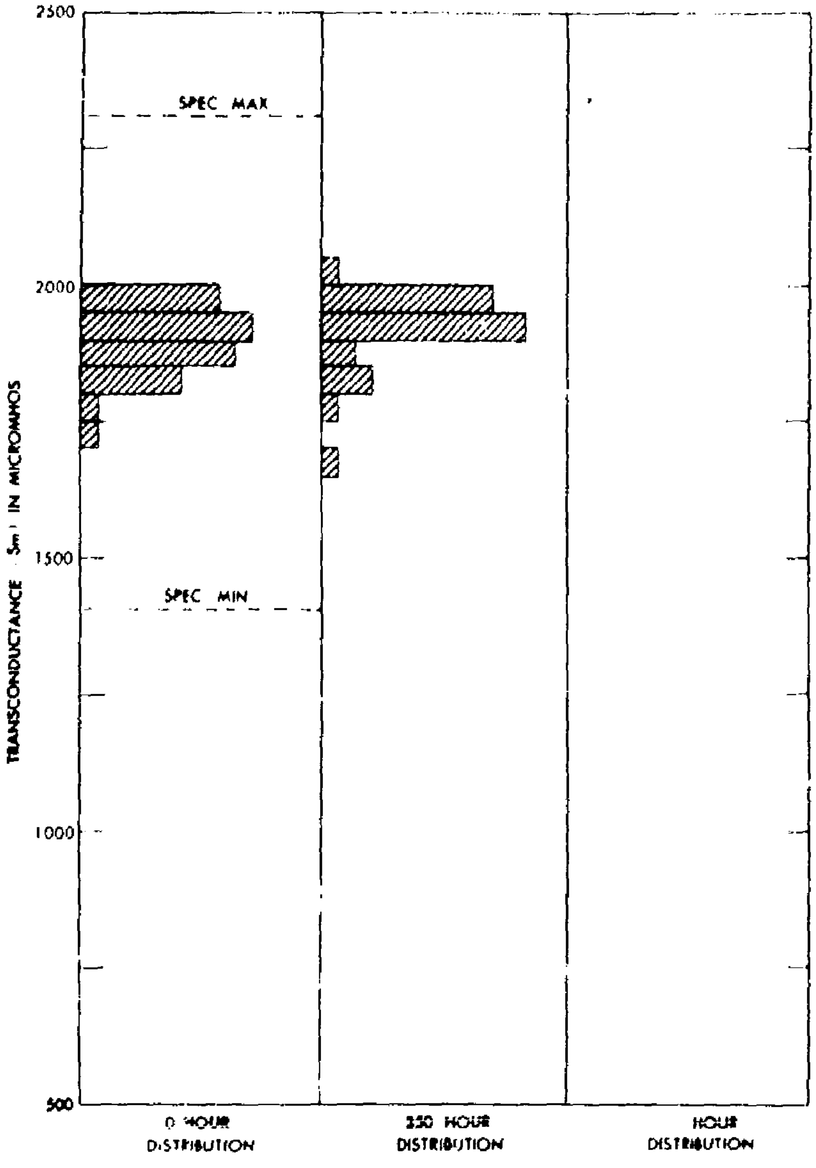


Figure 4-8. Distribution of Transconductance for JAN-3B4

4.4.2 The distribution curves below are based upon 30 tubes (6 lots) life-tested by one manufacturer of the type during the latter months of 1955. The specification limits shown are taken from MIL-E-1/34B dated 17 December 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

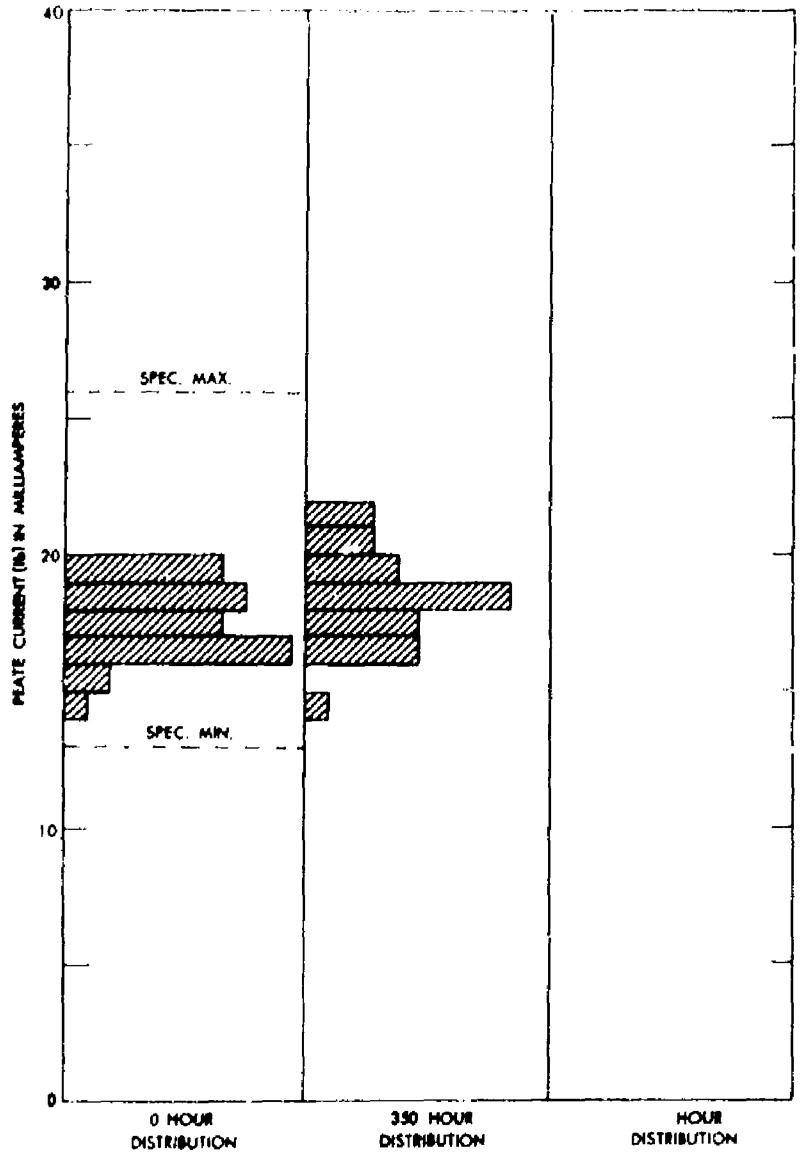


Figure 4-9. Distribution of Plate Current for JAN-3B4

4.4.3 The distribution curves below are based upon 30 tubes (6 lots) life-tested by one manufacturer of the type during the latter months of 1955. The specification limits shown are taken from MIL-E-1/34B dated 17 December 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

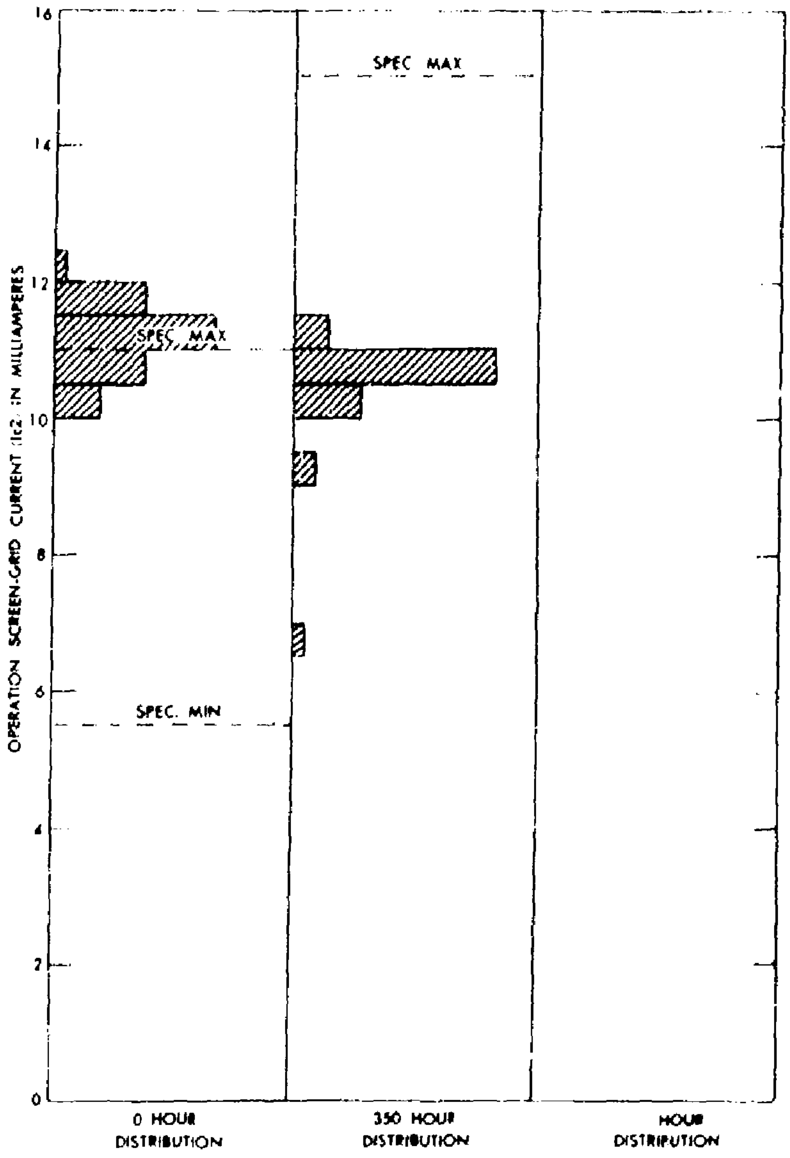


Figure 4-10. Distribution of Operations Screen Grid Current for JAN-3B4

4.5 DISTRIBUTION CURVES.

4.5.1 The distribution curves below are based upon 124 tubes life-tested by one manufacturer of the type during the year of 1955. The specification limits shown are taken from MIL-E-1/116A dated 4 March 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

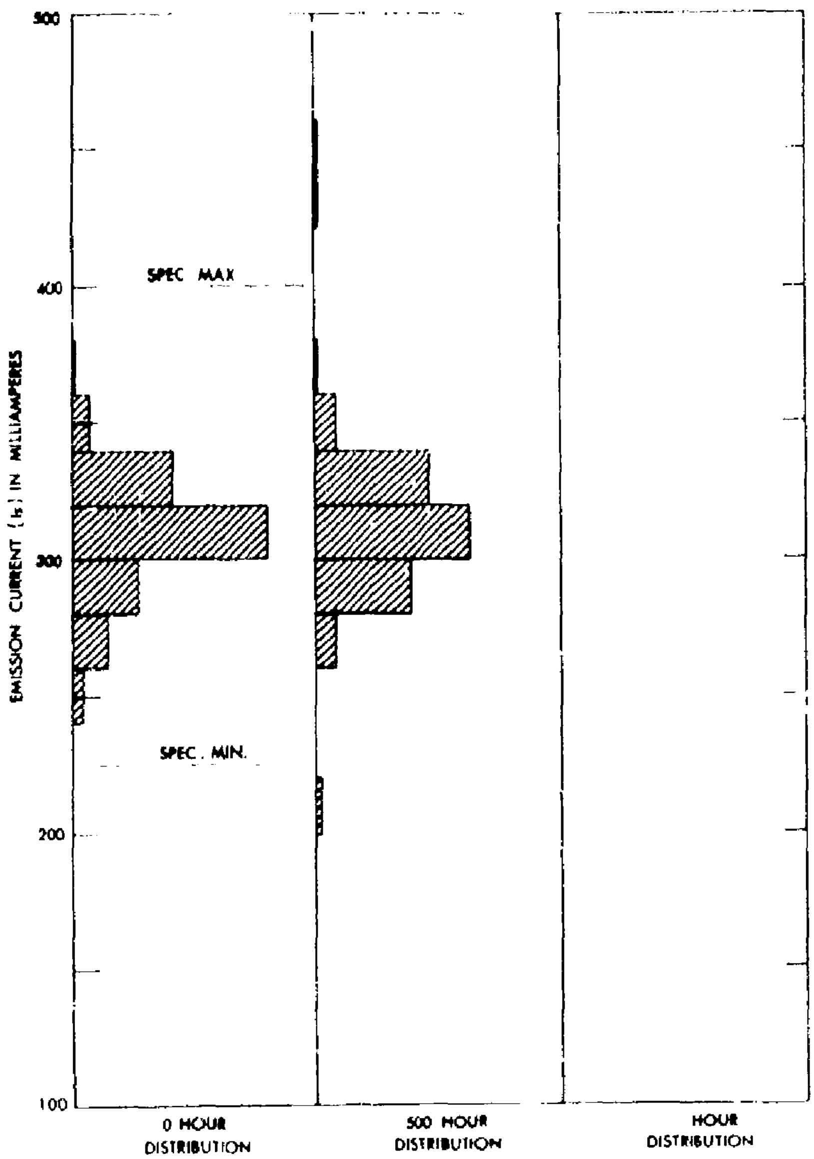


Figure 4-11. Distribution of Emission Current for JAN-5R4WGA

4.5.2 The distribution curves below are based upon 124 tubes life-tested by one manufacturer of the type during the year of 1955. The specification limits shown are taken from MIL-E-1/116A dated 4 March 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

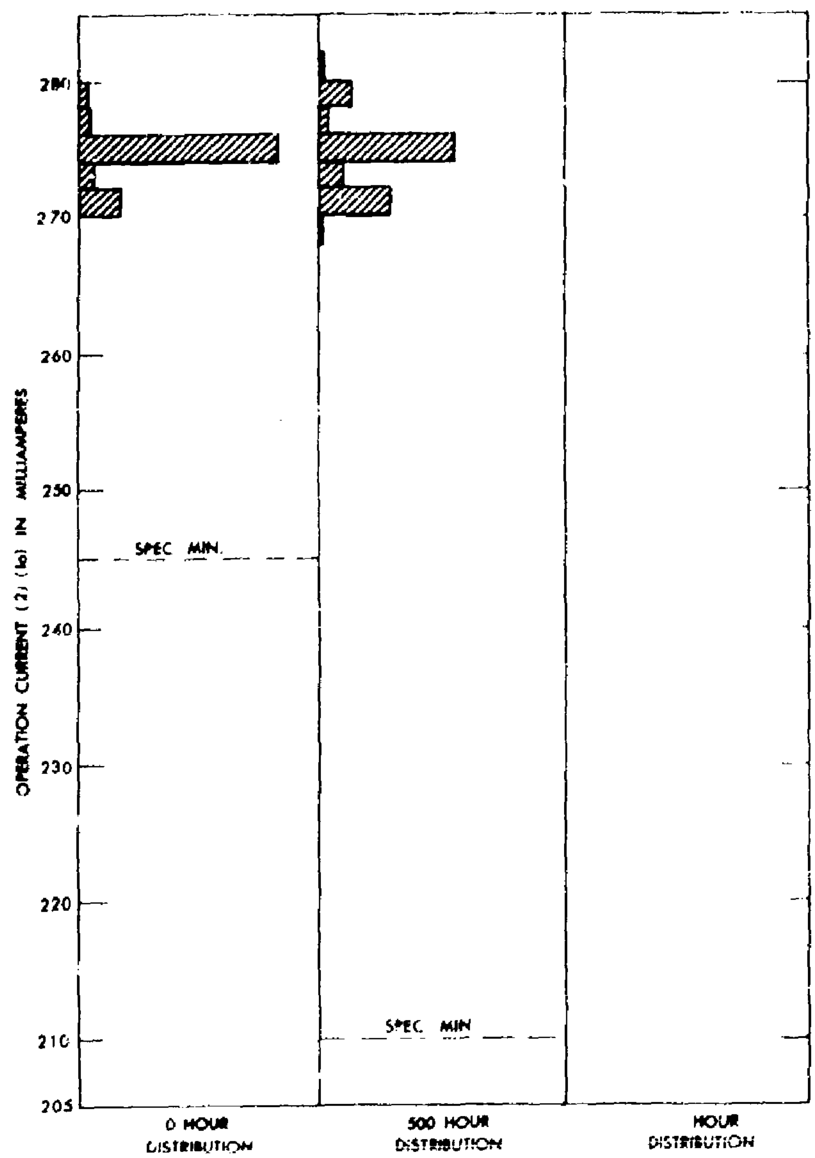


Figure 4-12. Distribution of Operation Current (2) for JAN-5R4WGA

4.6 DISTRIBUTION CURVES.

4.6.1 The distribution curves below are based upon 198 tubes life-tested by one manufacturer of this type during the period of September 1954 through February 1955. Only data on lots accepted by the specification is included. Tube failures within the accepted lots are included in the distribution curves. The specification limits shown are taken from MIL-E-1/44A dated 14 January 1954.

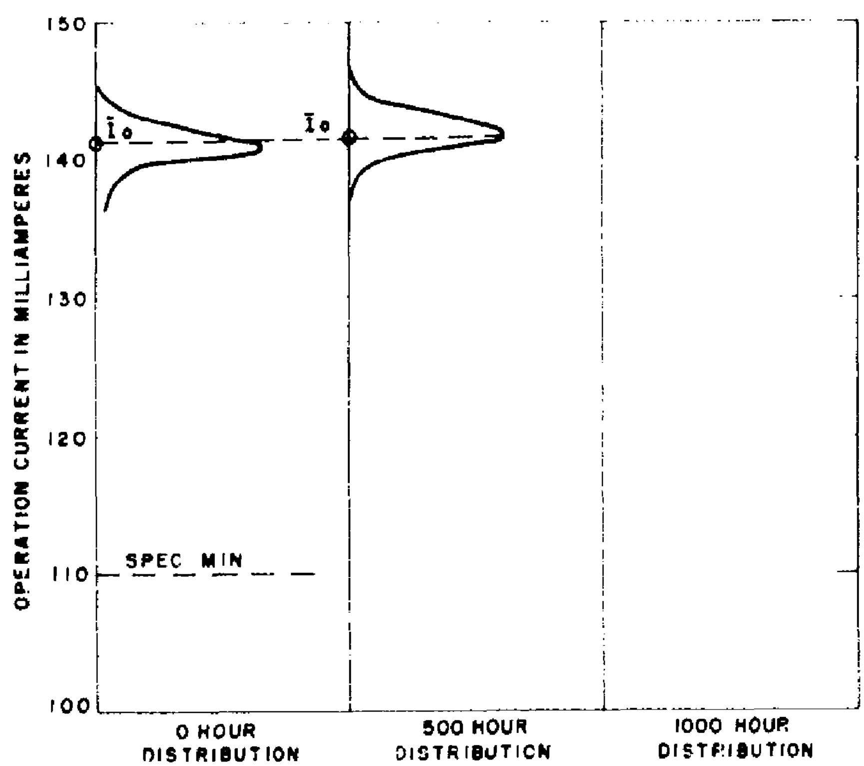


Figure 4-13. Distribution of Operation Current for JAN-5Y3WGTA

4.7 DISTRIBUTION CURVES.

4.7.1 The distribution curves below are based upon 210 tubes life-tested by two manufacturers of the type during the period from December 1954 through November 1955. The specification limits shown are taken from MIL-E-1/45A dated 30 March 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

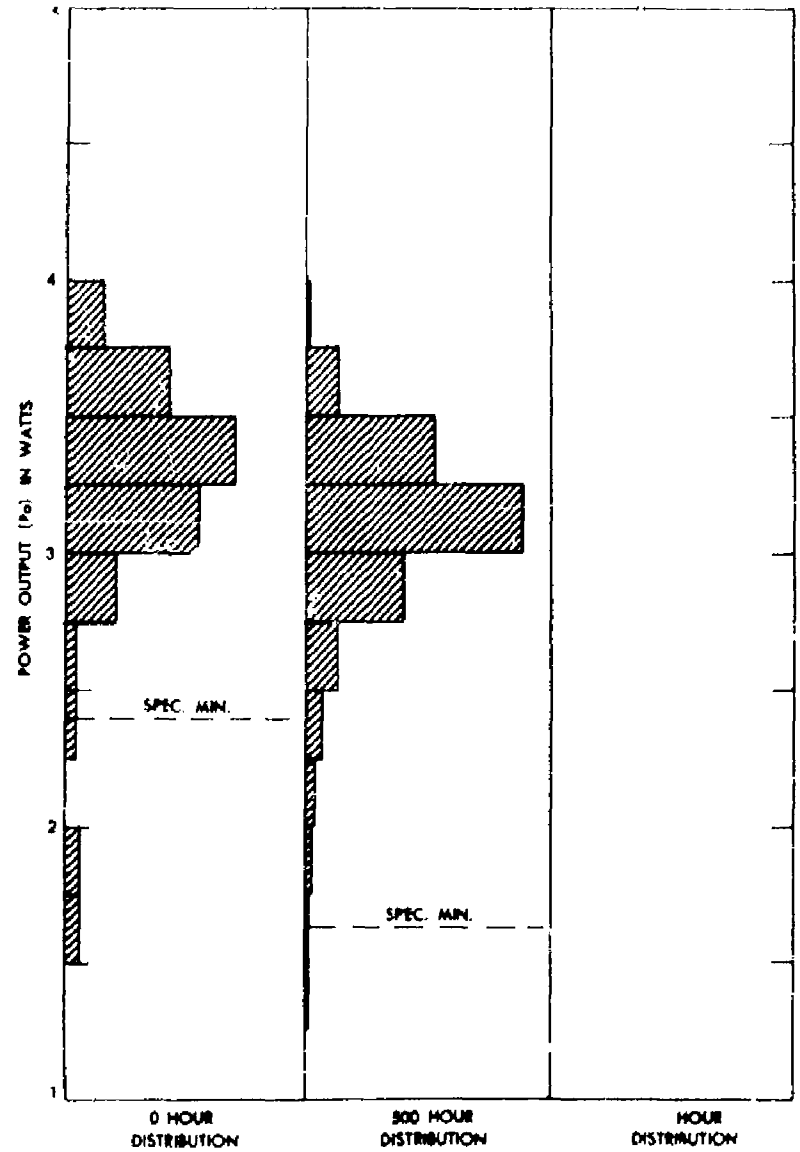


Figure 4-14. Distribution of Power Output for JAN-6AG7

4.7.2 The distribution curves below are based upon 210 tubes life-tested by two manufacturers of the type during the period from December 1954 through November 1955. The specification limits shown are taken from MIL-E-1/45A dated 30 March 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

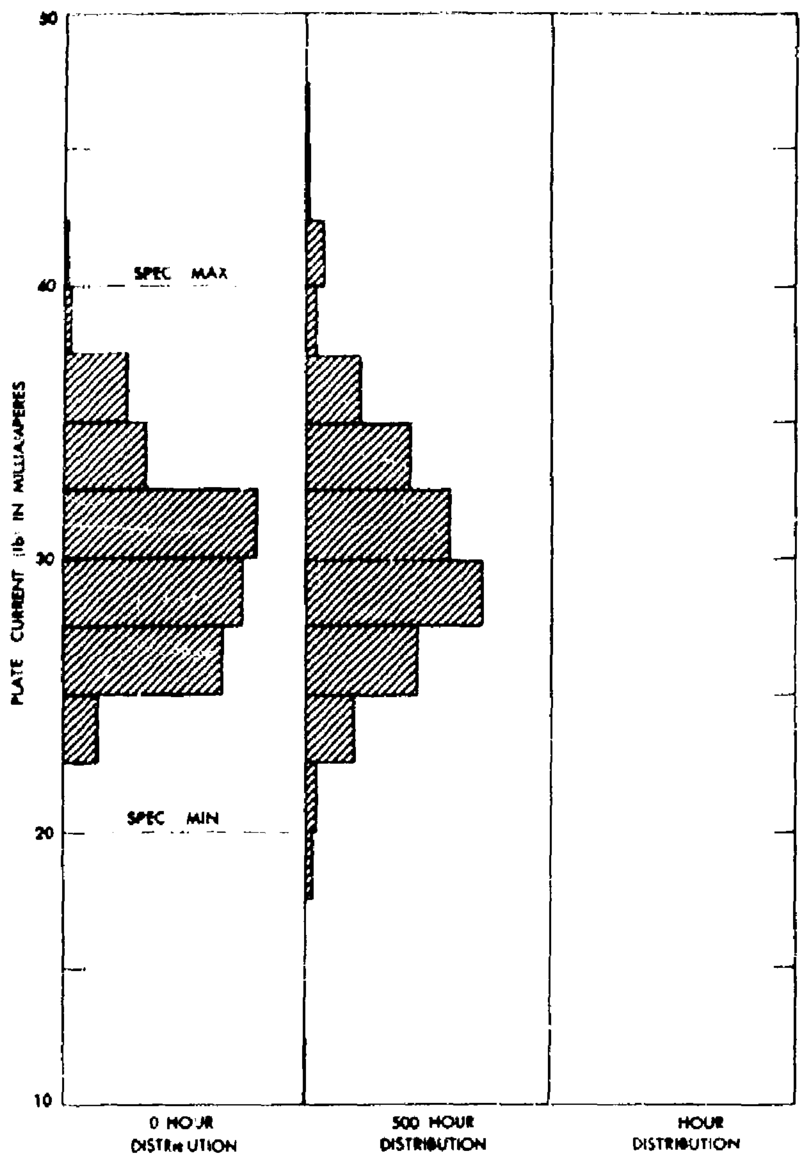


Figure 4-15. Distribution of Plate Current for JAN-6AG7

4.8 DISTRIBUTION CURVES.

4.8.1 The distribution curves below are based upon 250 tubes life-tested by one manufacturer of the type during the period of November 1954 through October 1955. The specification limits shown are taken from MIL-E-1/197 dated 20 May 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

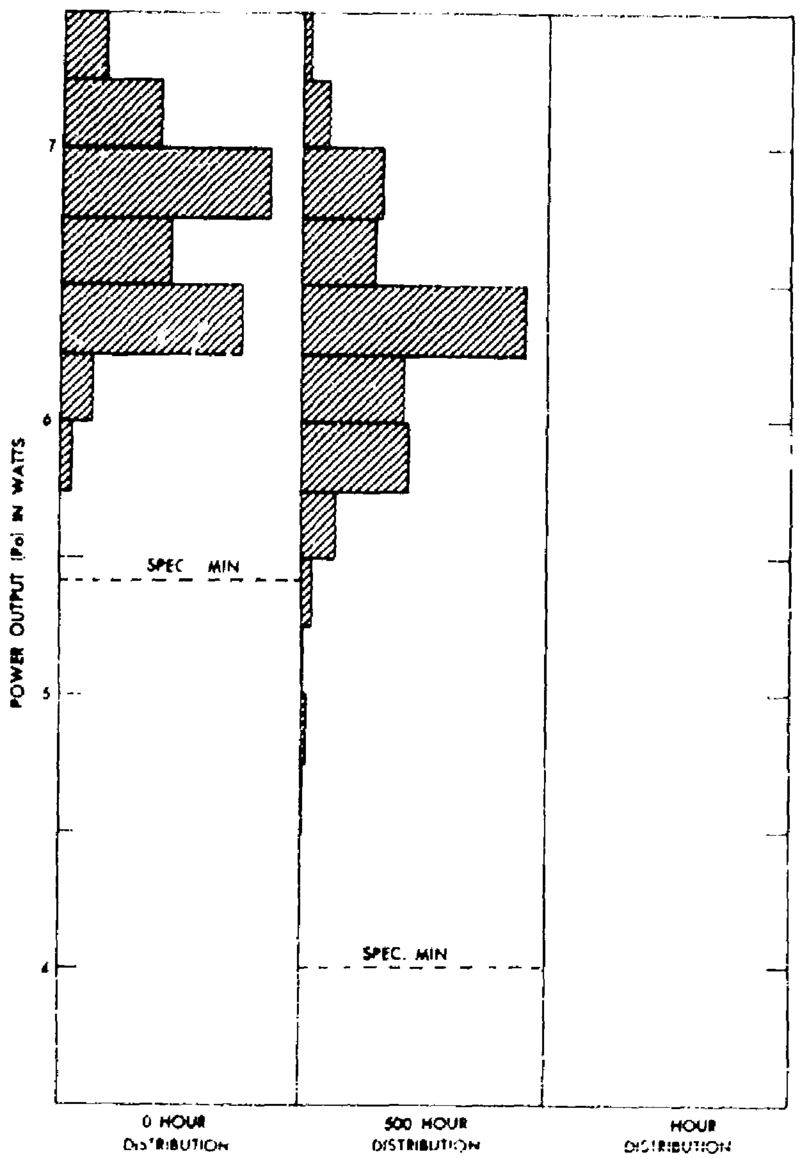


Figure 4-16. Distribution of Power Output for JAN-6L6WGB

4.8.2 The distribution curves below are based upon 250 tubes life-tested by one manufacturer of the type during the period of November 1954 through October 1955. The specification limits shown are taken from MIL-E-1/197 dated 20 May 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

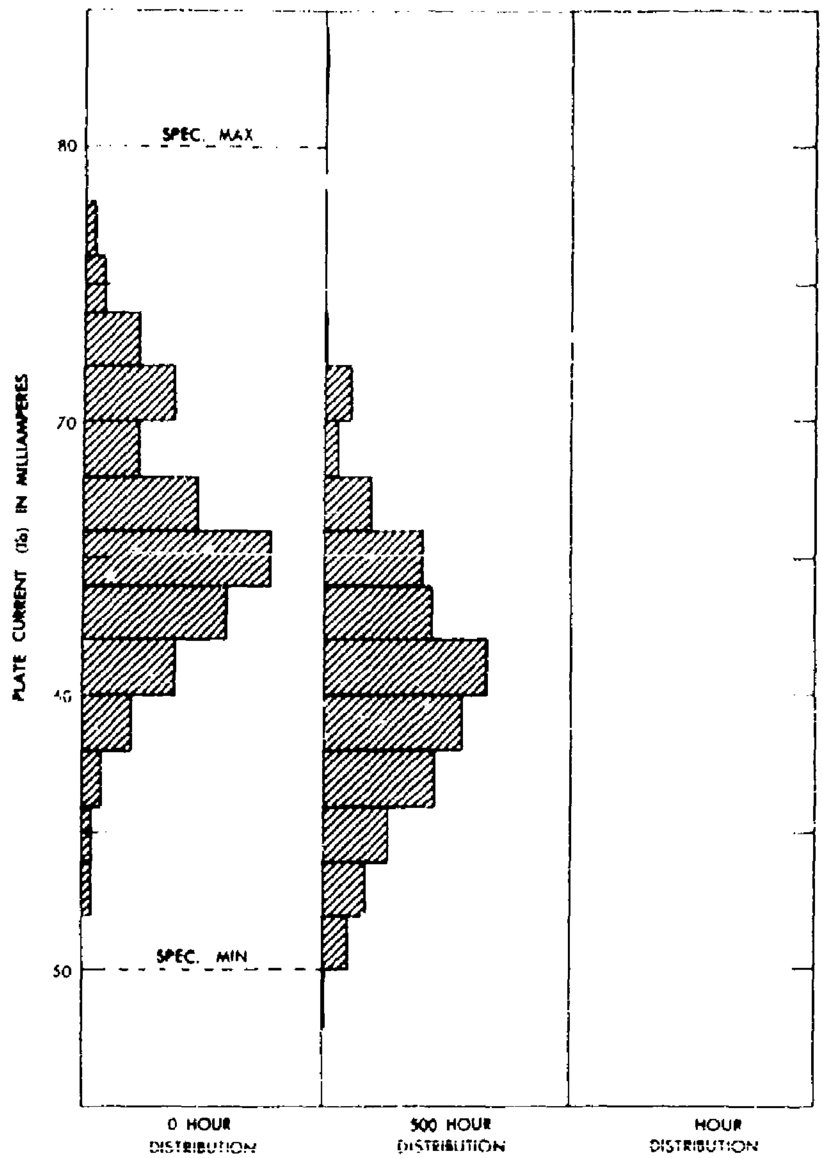


Figure 4-17. Distribution of Plate Current for JAN-6L6WGB

4.8.3 The distribution curves below are based upon 250 tubes life-tested by one manufacturer of the type during the period of November 1954 through October 1955. The specification limits shown are taken from MIL-E-1/197 dated 20 May 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

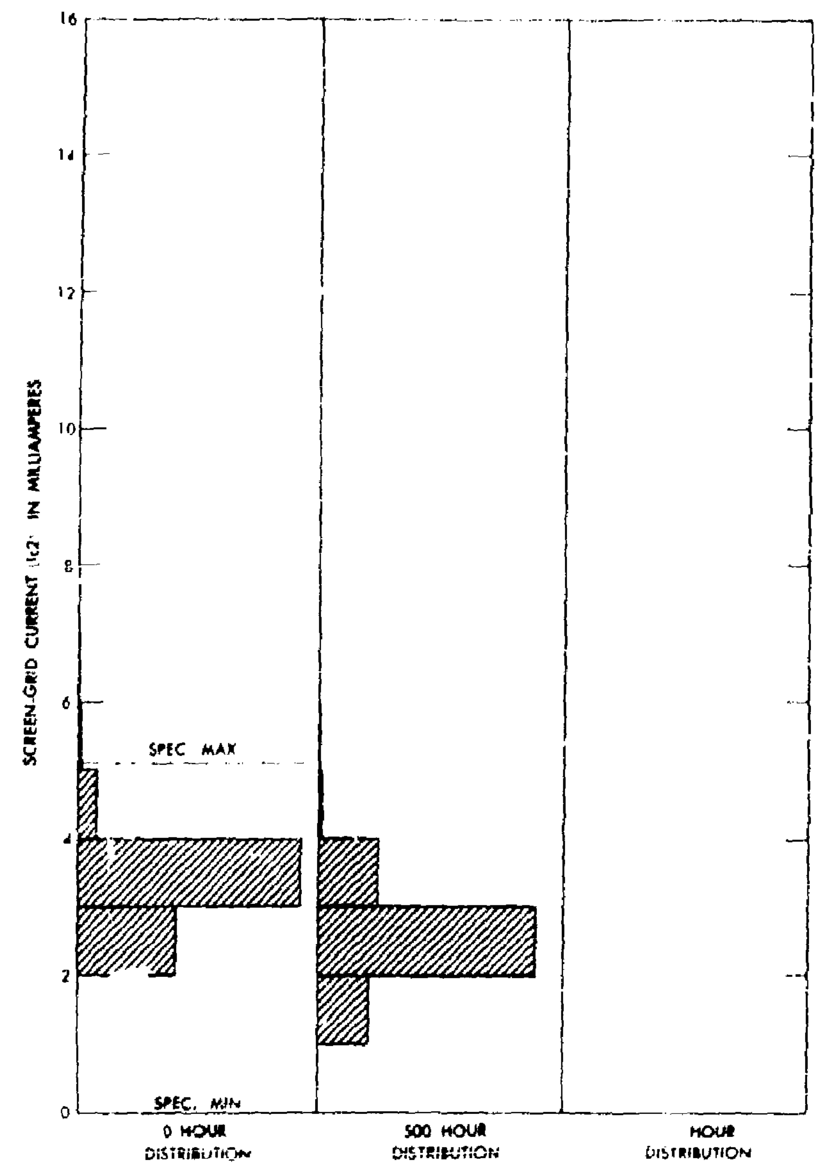


Figure 4-18. Distribution of Screen Grid Current for JAN-6L6WGB

PROPERTY BEHAVIOR FOR JAN-5636

4.9 DISTRIBUTION CURVES.

4.9.1 The distribution curves below are based upon 600 tubes life-tested by two manufacturers of the type during the period of June 1955 through December 1955. The specification limits shown are taken from MIL-E-1/168C dated 23 June 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

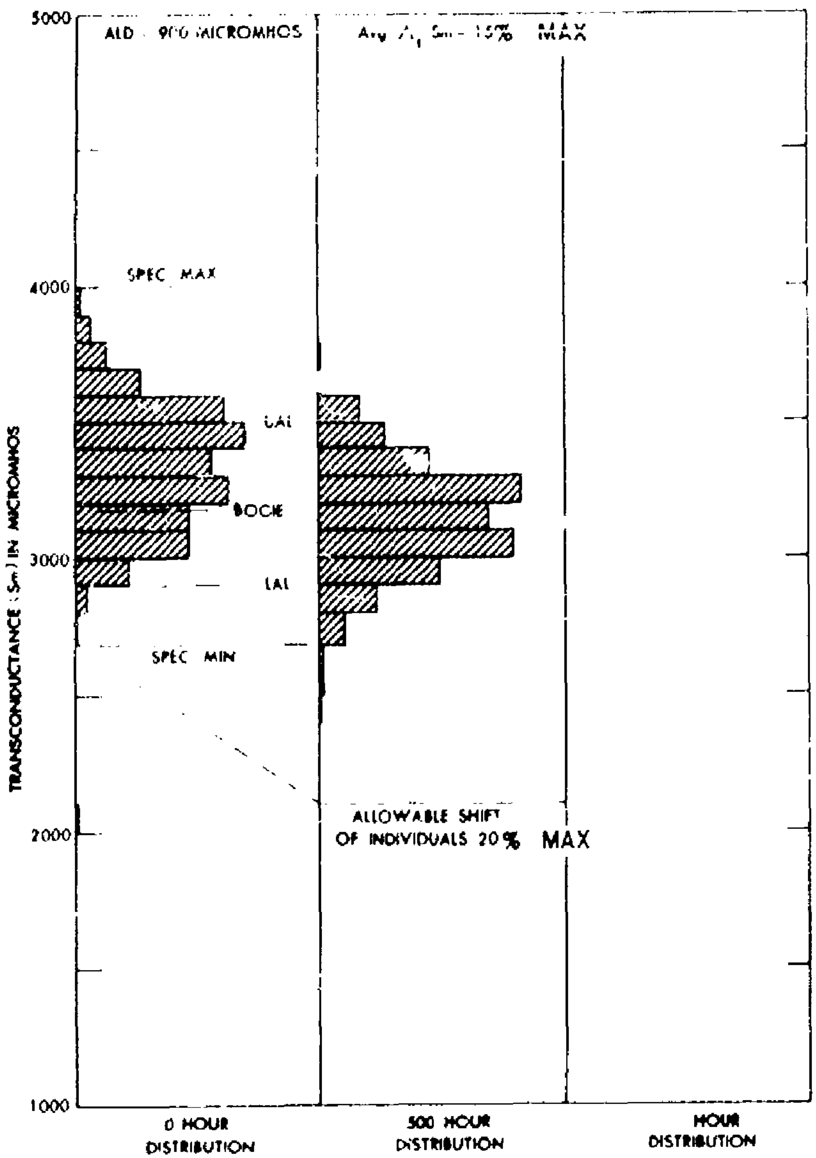


Figure 4-19. Distribution of Transconductance for JAN-5636

4.9.2 The distribution curves below are based upon 600 tubes life-tested by two manufacturers of the type during the period of June 1955 through December 1955. The specification limits shown are taken from MIL-E-1/168C dated 23 June 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

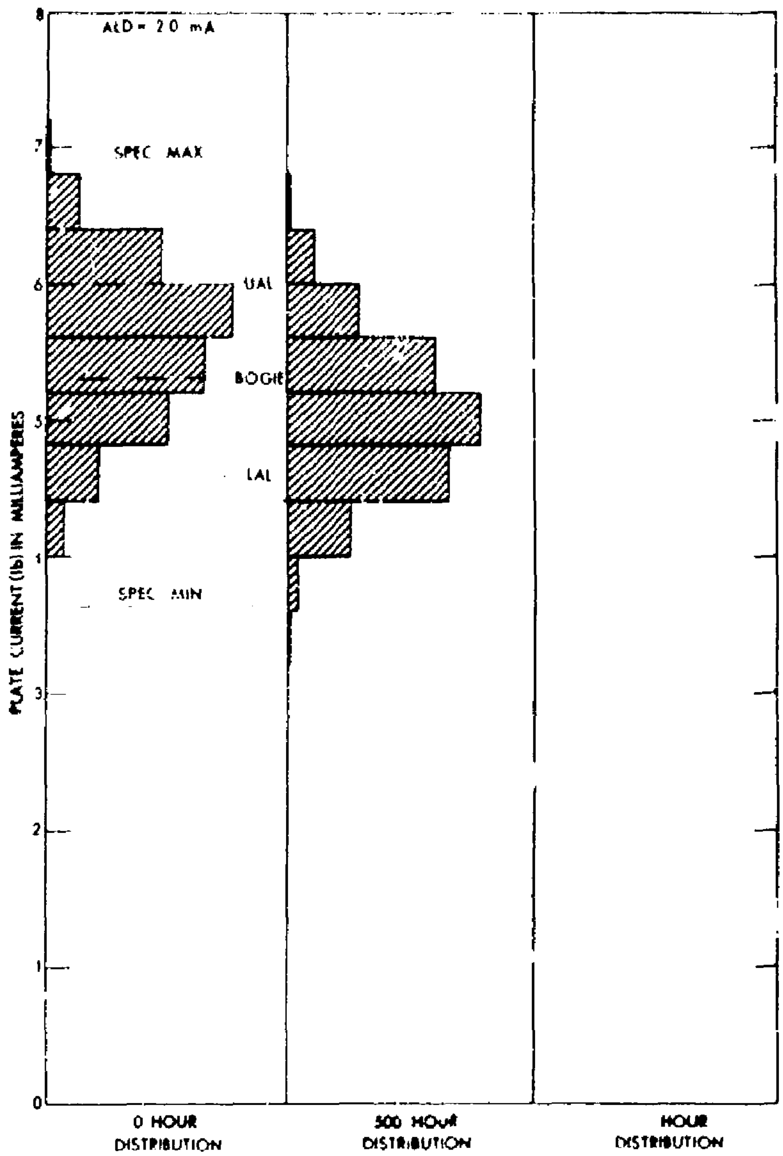


Figure 4-20. Distribution of Plate Current for JAN-5636

4.9.3 The distribution curves below are based upon 600 tubes life-tested by two manufacturers of the type during the period of June 1955 through December 1955. The specification limits shown are taken from MIL-E-1/168C dated 23 June 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

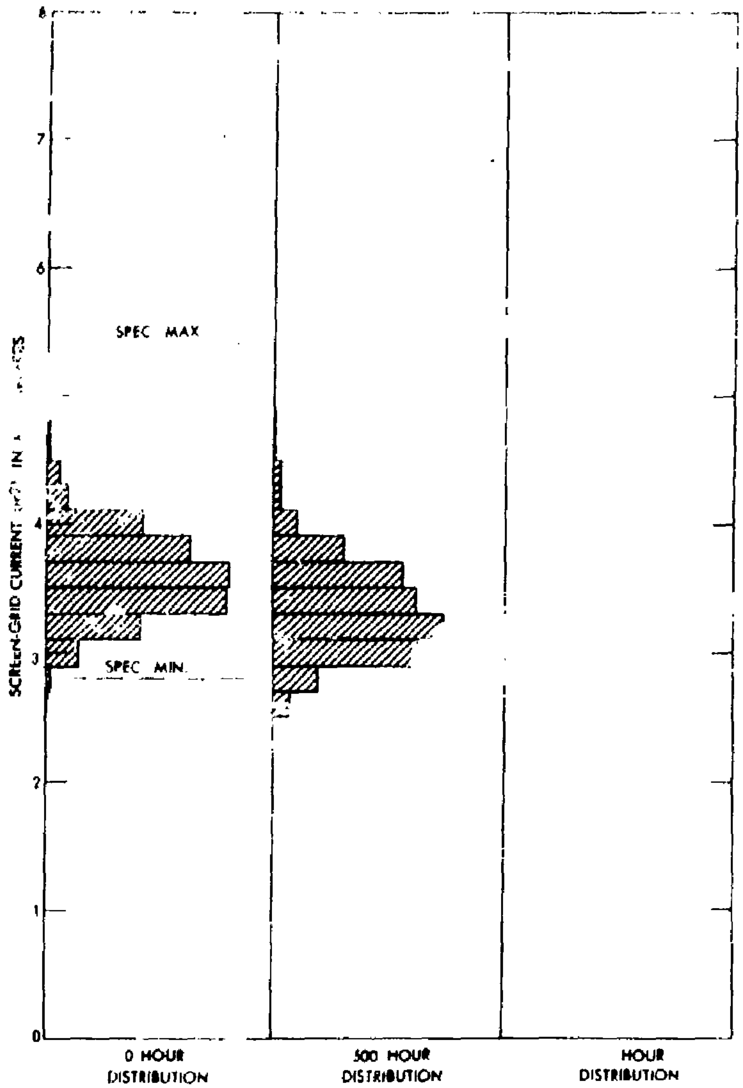


Figure 4-21. Distribution of Screen Grid Current for JAN-5636

OPERTY BEHAVIOR FOR JAN-5654/6AK5W

4.10 DISTRIBUTION CURVES.

4.10.1 The distribution curves below are based upon more than 500 tubes life-tested by both manufacturers of the tube type during the period of November 1951 through March 1952. Only the data on lots accepted by the specification are included. Tube failures within the accepted lots are included in the distribution curves. The life-test limits indicated are taken from the specification dated 26 January 1953.

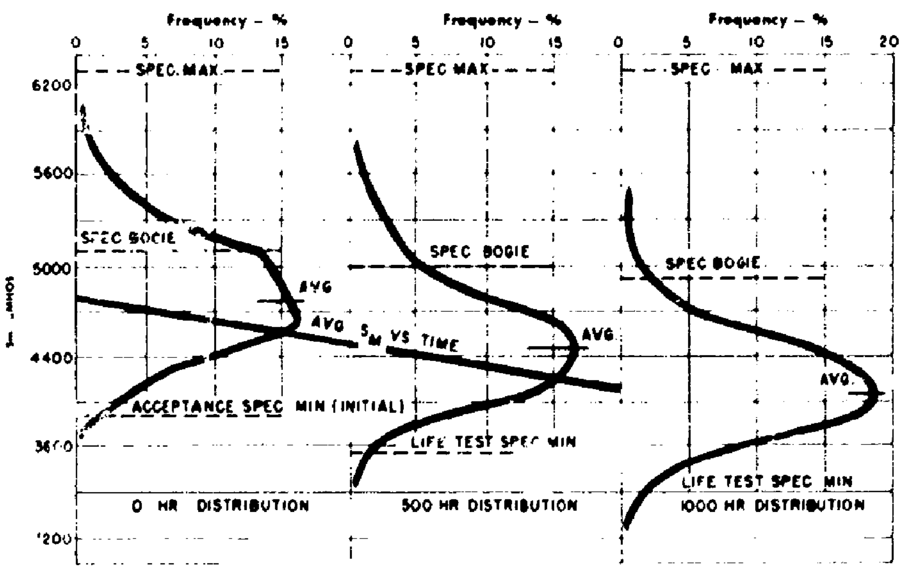


Figure [illegible] Distribution of Transconductance [illegible]-5654/6AK5W

PROPERTY BEHAVIOR FOR JAN-5670

4.11 DISTRIBUTION CURVES.

4.11.1 These distribution curves are based upon 786 tubes representing tubes from three manufacturers ranging in date of production from October 1952 through April 1954. The 1000 hour data were insufficient to establish a distribution. The sample average is permitted by specification to shift as much as 20% during the first 500 hours of life test.

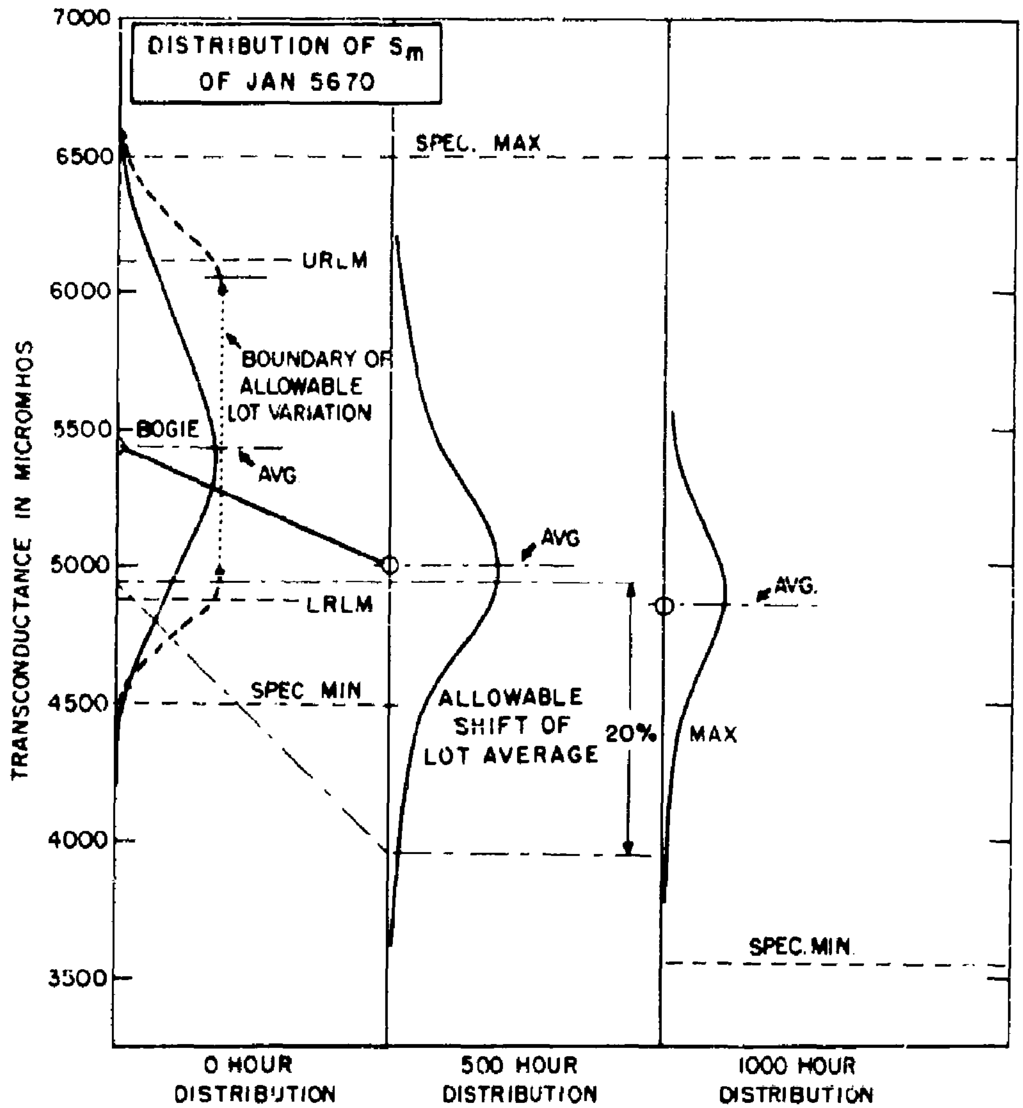


Figure 4-23. Distribution of Transconductance for JAN-5670

4.12 DISTRIBUTION CURVES.

4.12.1 The distribution curves below are based upon 268 tubes life-tested by two manufacturers of the type during the period of December 1952 through March 1955. Only data on lots accepted by the specification is included. Tube failures within the acceptance lots are included in the distribution curves. The specification limits shown are taken from MIL-E-1/280 dated 9 July 1953.

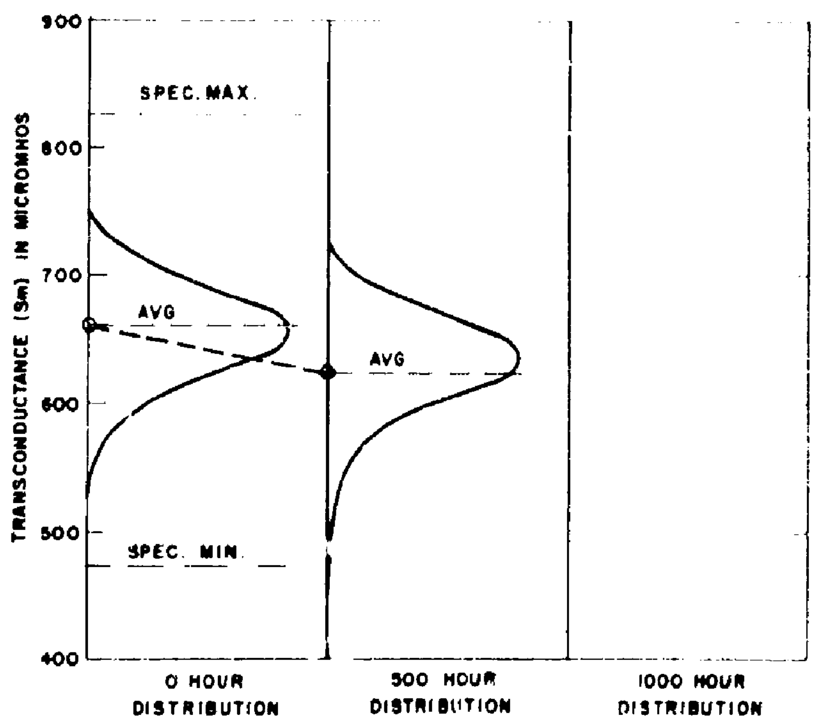


Figure 4-24. Distribution of Transconductance for JAN-5672

PROPERTY BEHAVIOR FOR JAN-5686

4.13 DISTRIBUTION CURVES.

4.13.1 The distribution curves below are based upon 442 tubes life-tested by one manufacturer of the type during the years 1954 and 1955. The specification limits shown are taken from MIL-E-1/171 dated 20 May 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

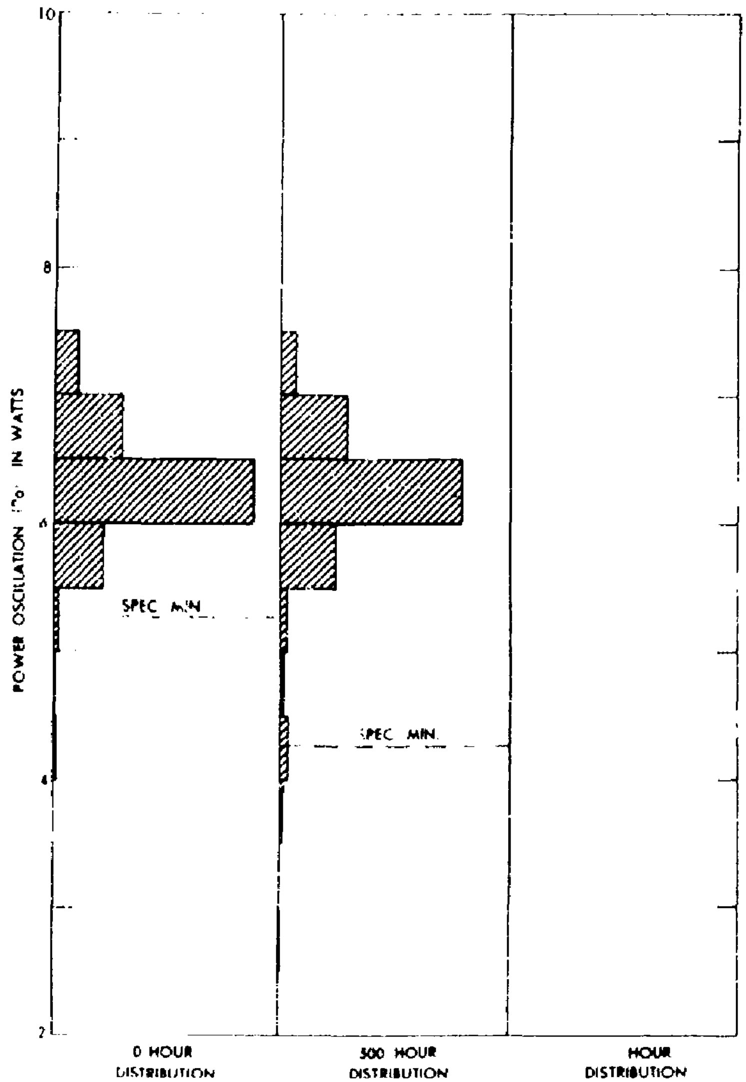


Figure 4-25. Distribution of Power Oscillation for JAN-5686

4.13.2 The distribution curves below are based upon 442 tubes life-tested by one manufacturer of the type during the years 1954 and 1955. The specification limits shown are taken from MIL-E-1/171 dated 20 May 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

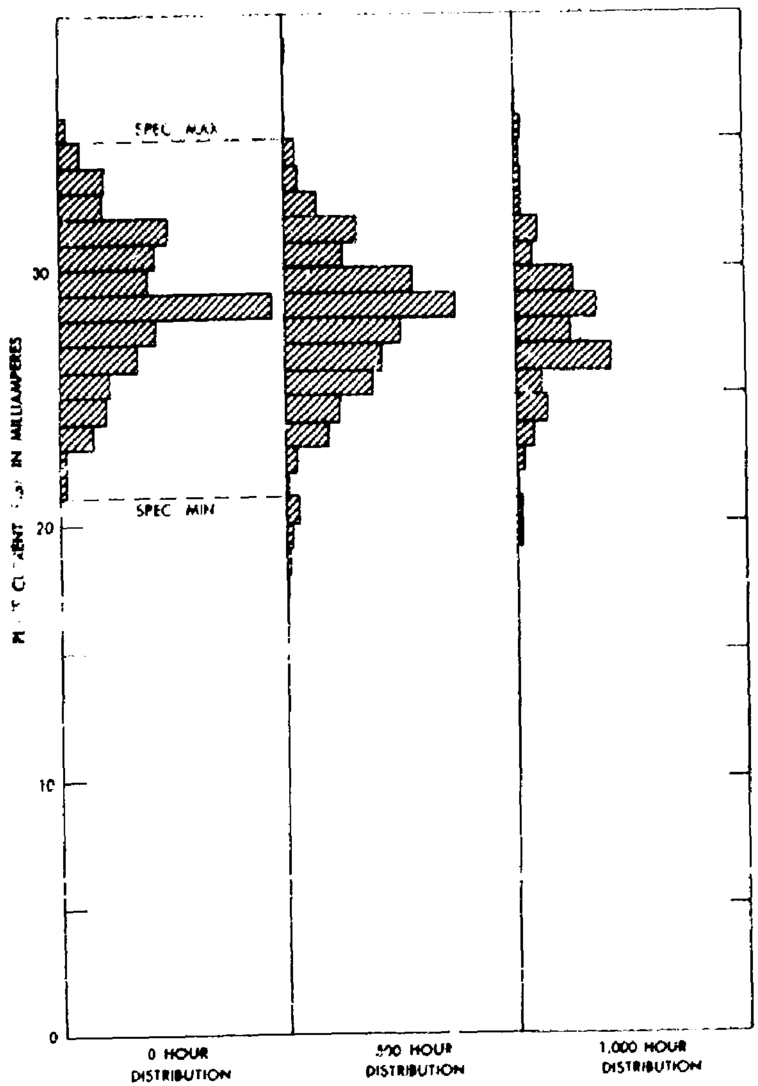


Figure 4-26. Distribution of Plate Current for JAN-5686

4.13.3 The distribution curves below are based upon 442 tubes life-tested by one manufacturer of the type during the years 1954 and 1955. The specification limits shown are taken from MIL-E-1/171 dated 20 May 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

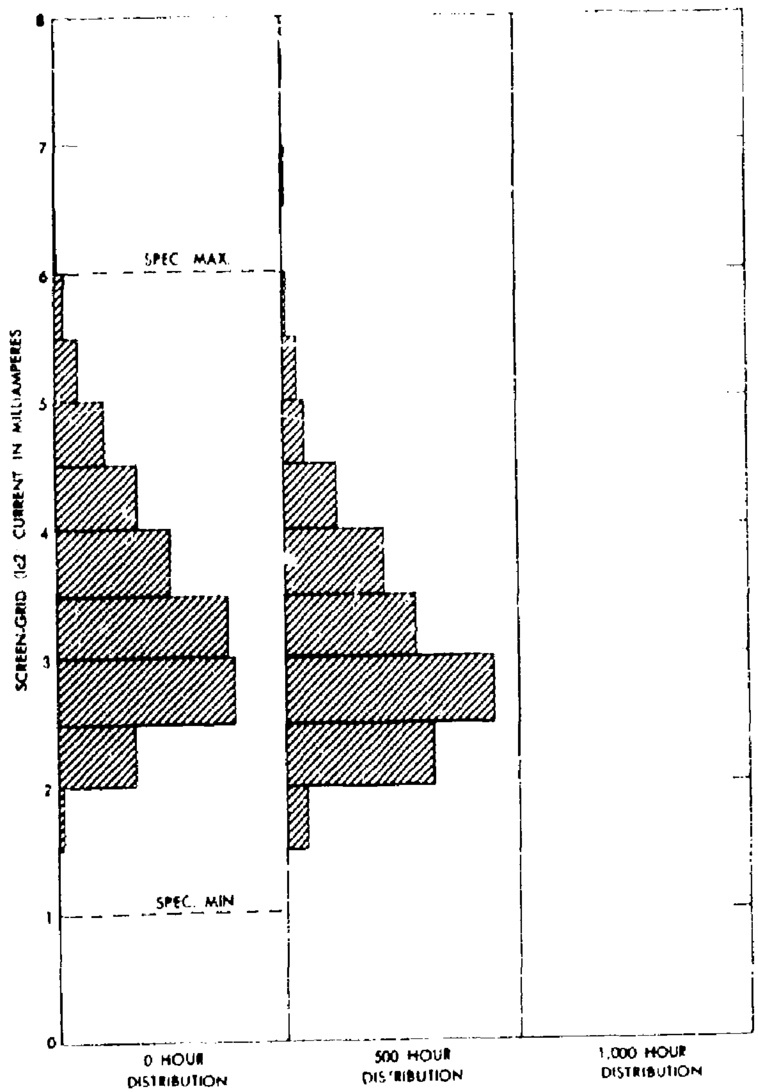


Figure 4-27. Distribution of Screen Grid Current for JAN-5686

PROPERTY BEHAVIOR FOR JAN-5687

4.14 DISTRIBUTION CURVES.

4.14.1 The distribution curves below are based upon 390 tubes life-tested by one manufacturer of the type during the years 1954 and 1955. The specification limits shown are taken from MIL-E-1/80B dated 16 July 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

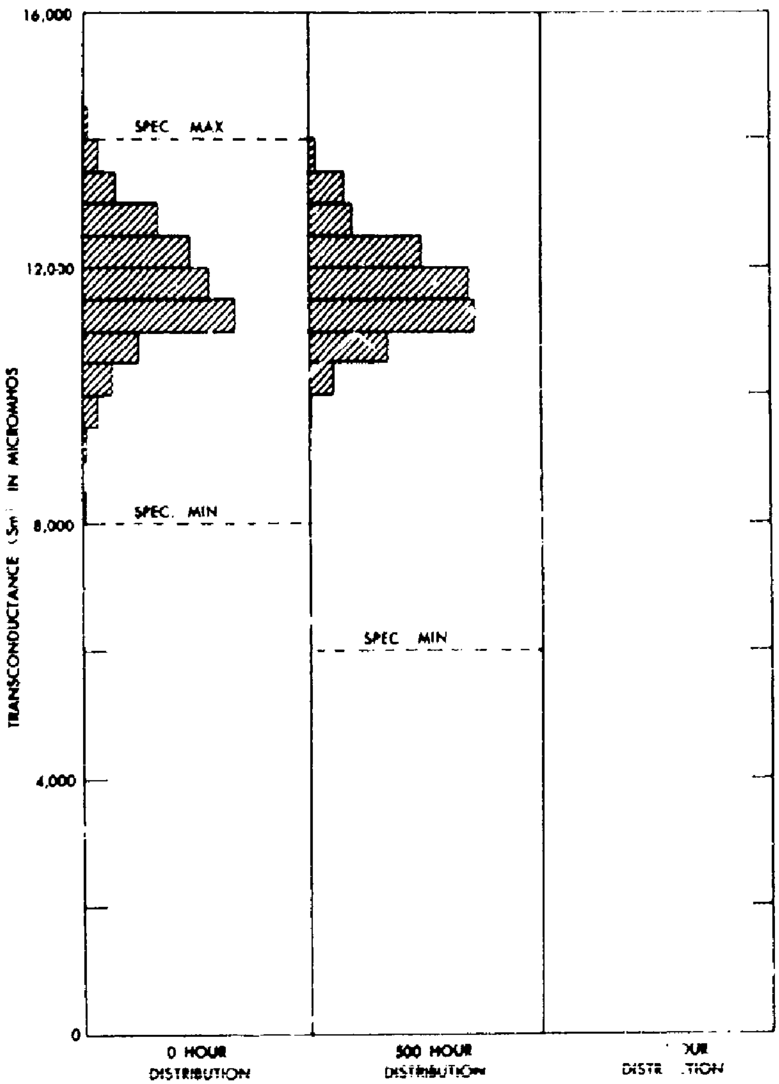


Figure 4-28. Distribution of Transconductance for JAN-5687

4.14.2 The distribution curves below are based upon 390 tubes life-tested by one manufacturer of the type during the years 1954 and 1955. The specification limits shown are taken from MIL-E-1/80B dated 16 July 1954. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

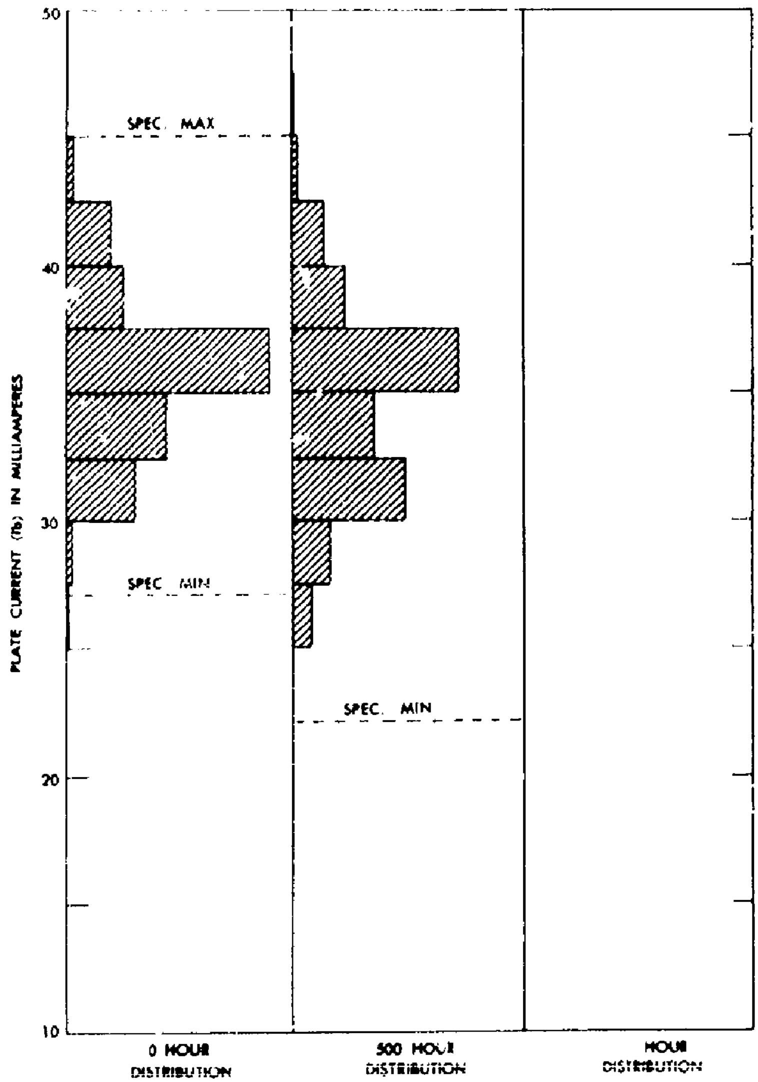


Figure 4-29. Distribution of Plate Current for JAN-5687

SECTION 15

PROPERTY BEHAVIOR FOR JAN-5702WA

4.15 DISTRIBUTION CURVES.

4.15.1 The distribution curves below are based upon 60 tubes life-tested by one manufacturer of the type during the period of April 1954 through November 1954. Only data on lots accepted by the specification is included. Tube failures within the accepted lots are included in the distribution curves. The specification limits shown are taken from MIL-E-1/82A dated 28 October 1953.

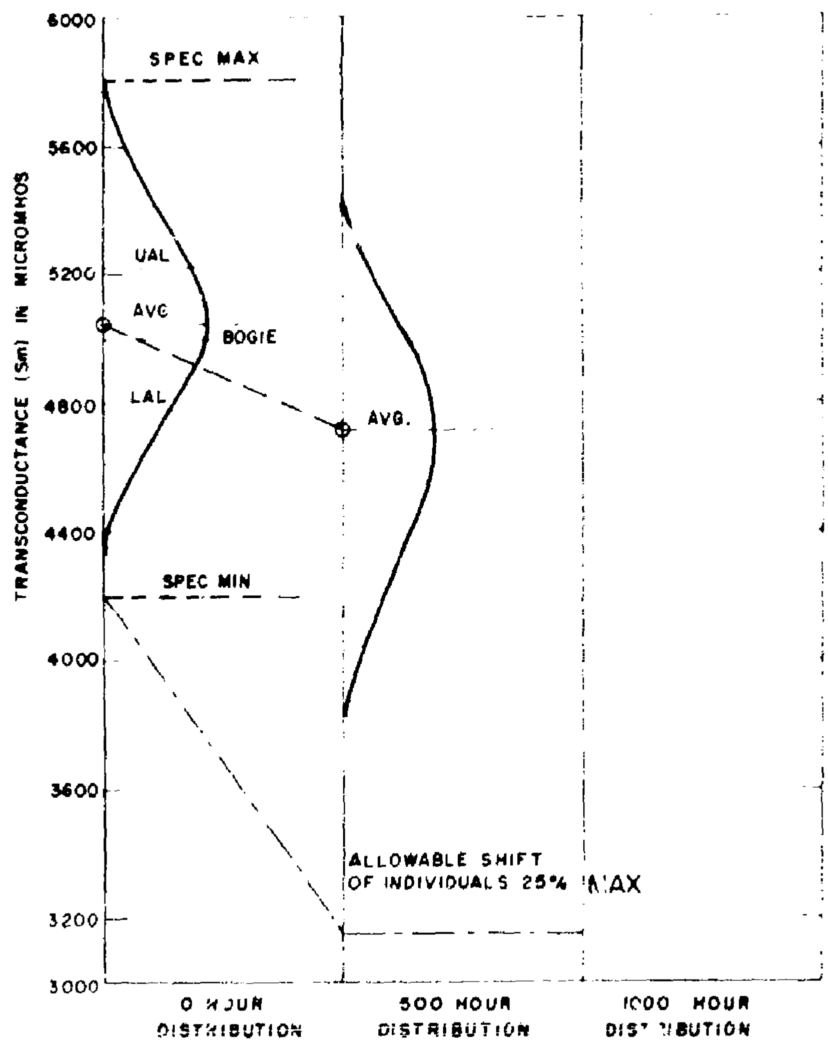


Figure 4-20. Distribution of Transconductance for JAN-5702WA

PROPERTY BEHAVIOR FOR JAN-5703WA

4.16 DISTRIBUTION CURVES.

4.16.1 The distribution curves below are based upon 90 tubes life-tested by one manufacturer of the type during the period of April 1954 through October 1954. Only data on lots accepted by the specification is included. Tube failures within the accepted lots are included in the distribution curves. The specification limits shown are taken from MIL-E-1/293A dated 16 July 1954.

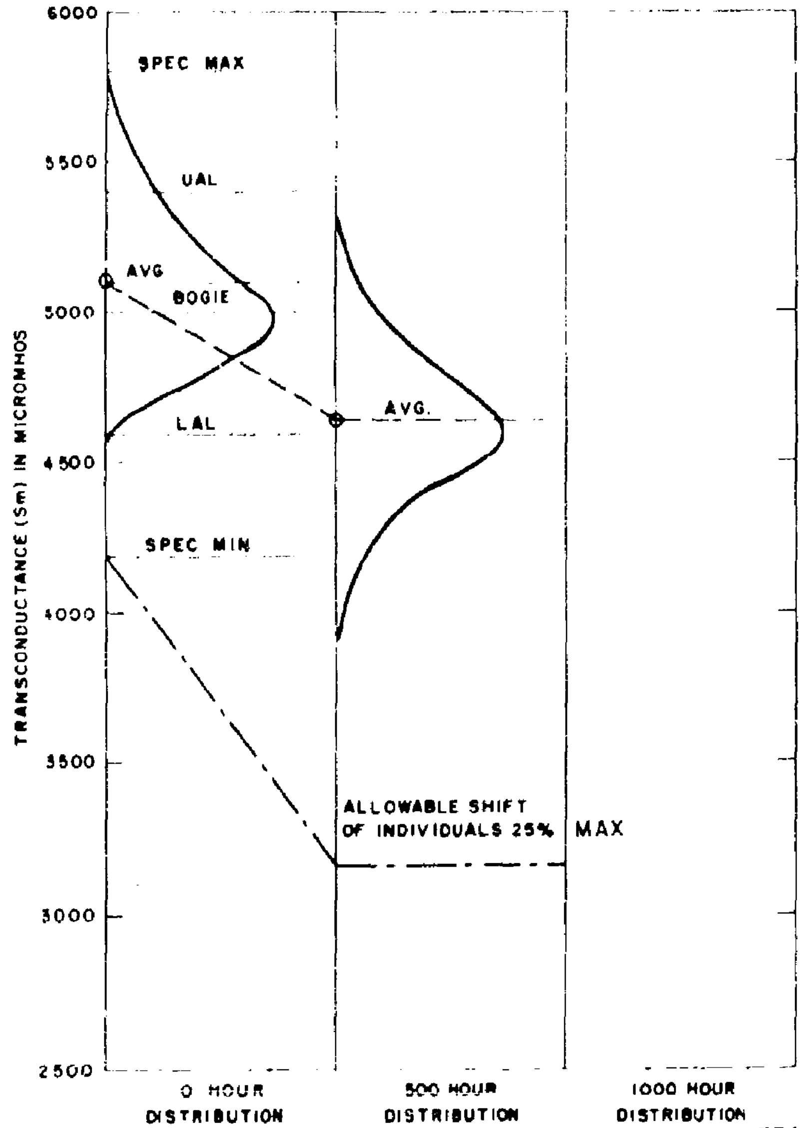


Figure 4-31. Distribution of Transconductance for JAN-5703WA

PROPERTY BEHAVIOR FOR JAN-5718

4.17 DISTRIBUTION CURVES.

4.17.1 The distribution curves below are based upon 970 tubes life-tested by five manufacturers of the type during the period of 1955 into 1956. The specification limits shown are taken from MIL-E-1/172B dated 5 August 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

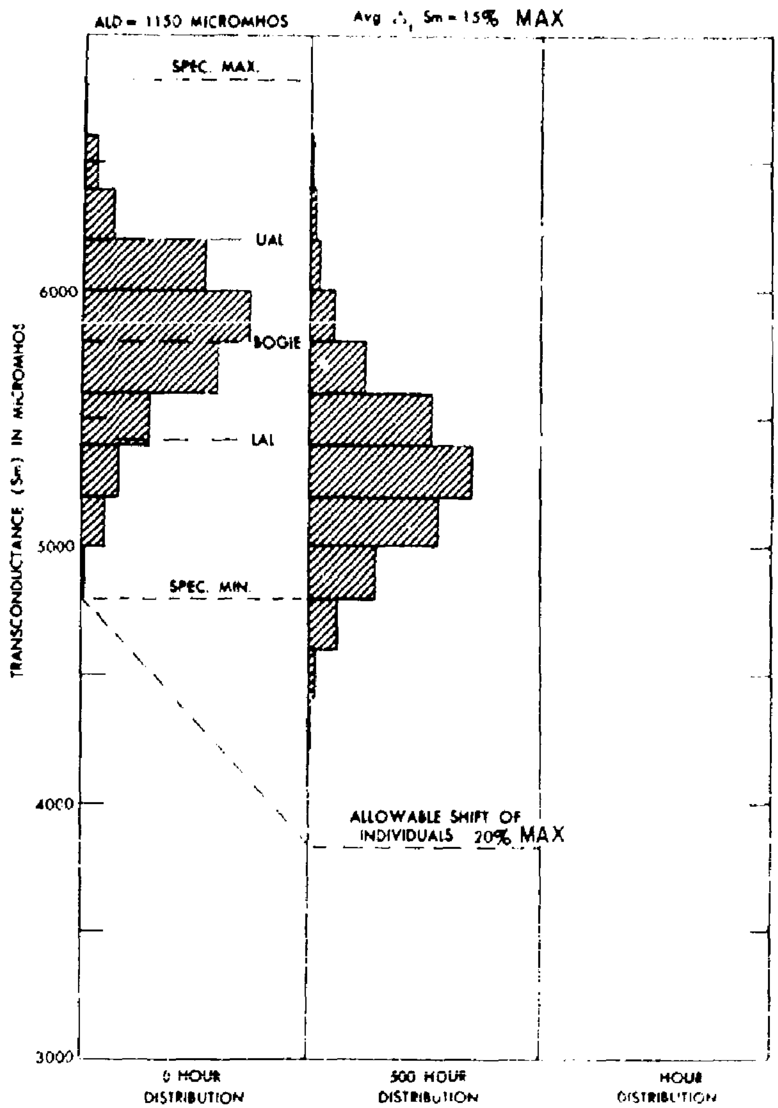


Figure 4-32. Distribution of Transconductance for JAN-5718

SECTION 19

PROPERTY BEHAVIOR FOR JAN-5719

4.18 DISTRIBUTION CURVES.

4.18.1 The distribution curves below are based upon 1245 tubes life-tested by five manufacturers of the type during the period of 1955 into 1956. The specification limits shown are taken from MIL-E-1/173C dated 5 August 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operable at the time associated with that curve.

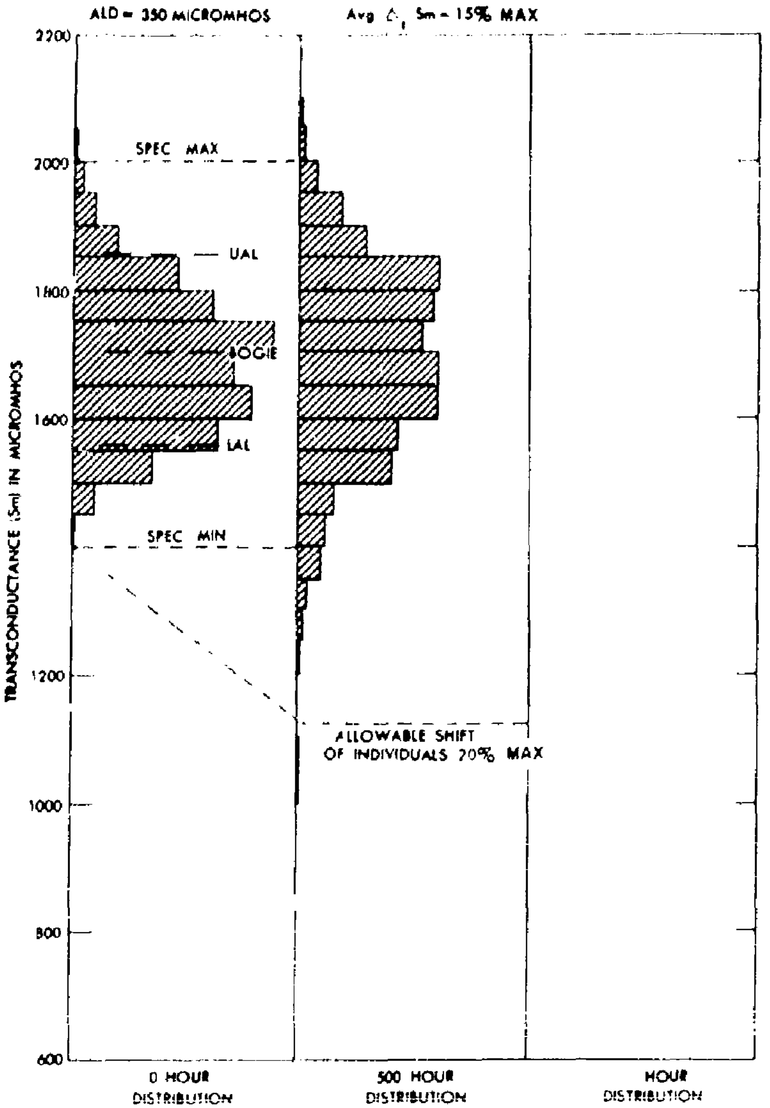


Figure 4-33. Distribution of Transconductance for JAN-5719

SECTION 19

PROPERTY BEHAVIOR FOR JAN-5744WA

4.19 DISTRIBUTION CURVES.

4.19.1 The distribution curves below are based upon 61 tubes life-tested by one manufacturer of the type during the period of March 1954 through October 1954. Only data on lots accepted by the specification is included. Tube failures within the accepted lots are included in the distribution curves. The specification limits shown are taken from MIL-E-1/84B dated 16 July 1954.2

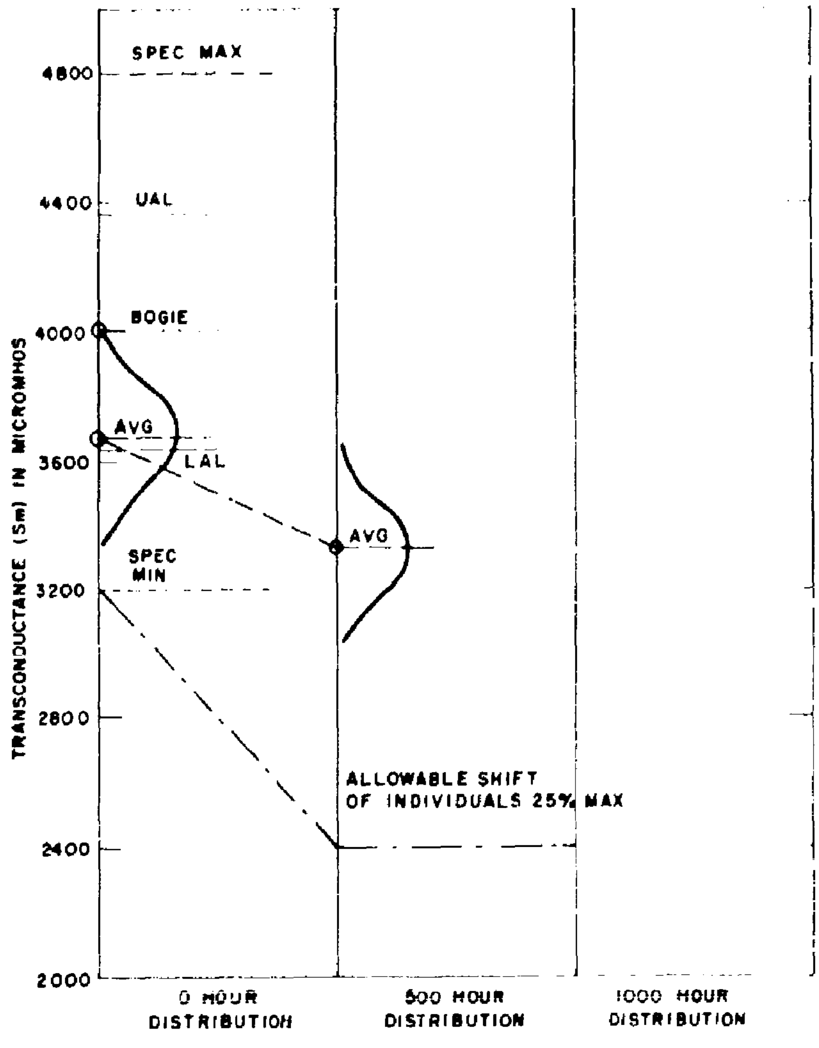


Figure 4-34. Distribution of Transconductance for JAN-5744WA

SECTION 20

PROPERTY BEHAVIOR FOR JAN-5750/6BE6W

4.20 DISTRIBUTION CURVES.

4.20.1 The distribution curves below are based upon 422 tubes life-tested by one manufacturer of the type during the years of 1954 and 1955. The specification limits shown are taken from MIL-E-1/9 dated 13 January 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

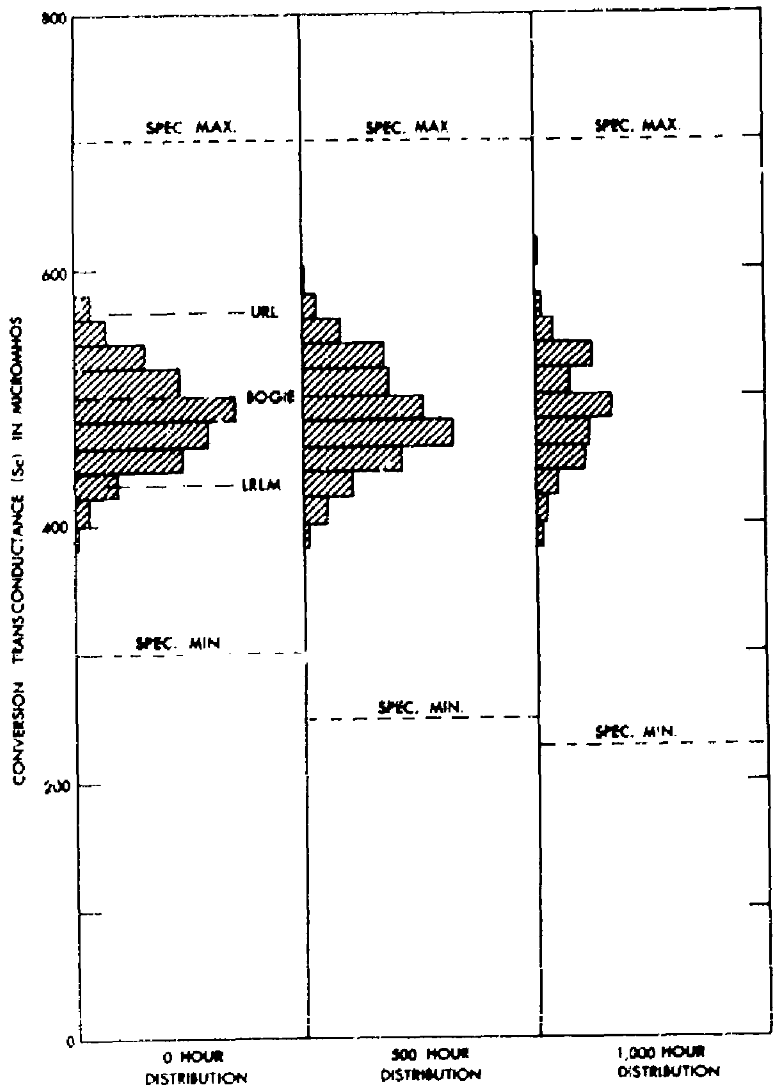


Figure 4-35. Distribution of Converstion Transconductance for JAN-5750/6BE6W

4.20.2 The distribution curves below are based upon 422 tubes life-tested by one manufacturer of the type during the years of 1954 and 1955. The specification limits shown are taken from MIL-E-1/9 dated 13 January 1953. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

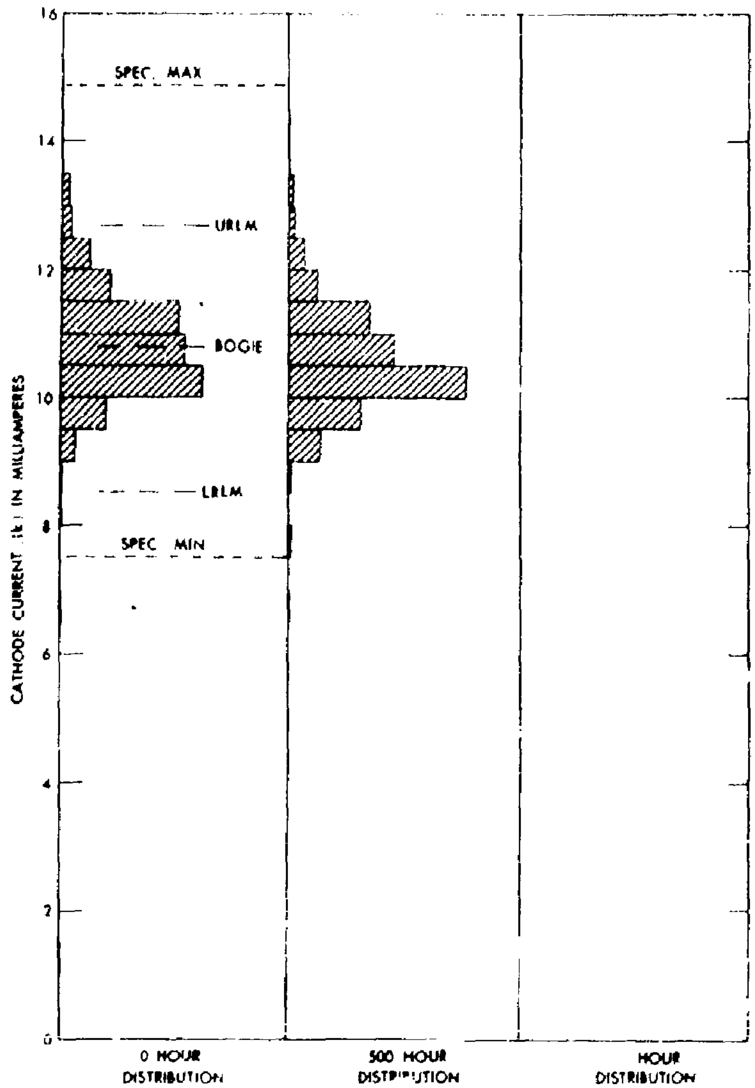


Figure 4-36. Distribution of Cathode Current for JAN-5750/6BE6W

SECTION 21

PROPERTY BEHAVIOR FOR JAN-5751

4.21 DISTRIBUTION CURVES.

4.21.1 These distribution curves are based on data for 930 tubes from two manufacturers. Production dates range from January 1953 through June 1954. Only data from lots accepted by the spe ation is included. The distribution average for AC amplification is permitted hift as much as 17 percent during the first 500 hours of life test.

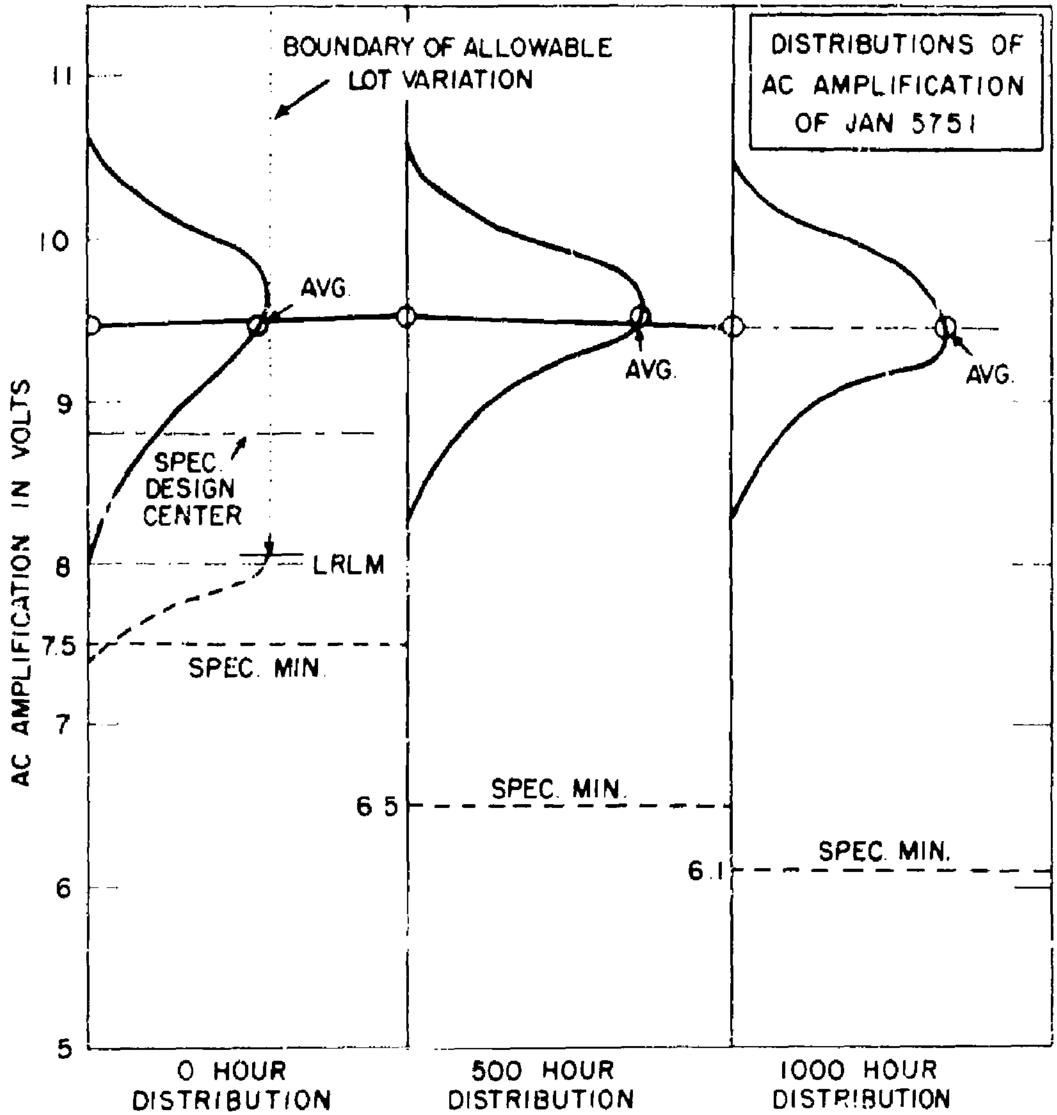


Figure 4-37. Distribution of AC Amplification for JAN-5751

SECTION 22

PROPERTY BEHAVIOR FOR JAN-6080WA

4.22 DISTRIBUTION CURVES.

4.22.1 The distribution curves below are based upon 380 tubes life-tested by one manufacturer of the type during the period of January 1955 through October 1955. The specification limits shown are taken from MIL-E-1/510B dated 5 December 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

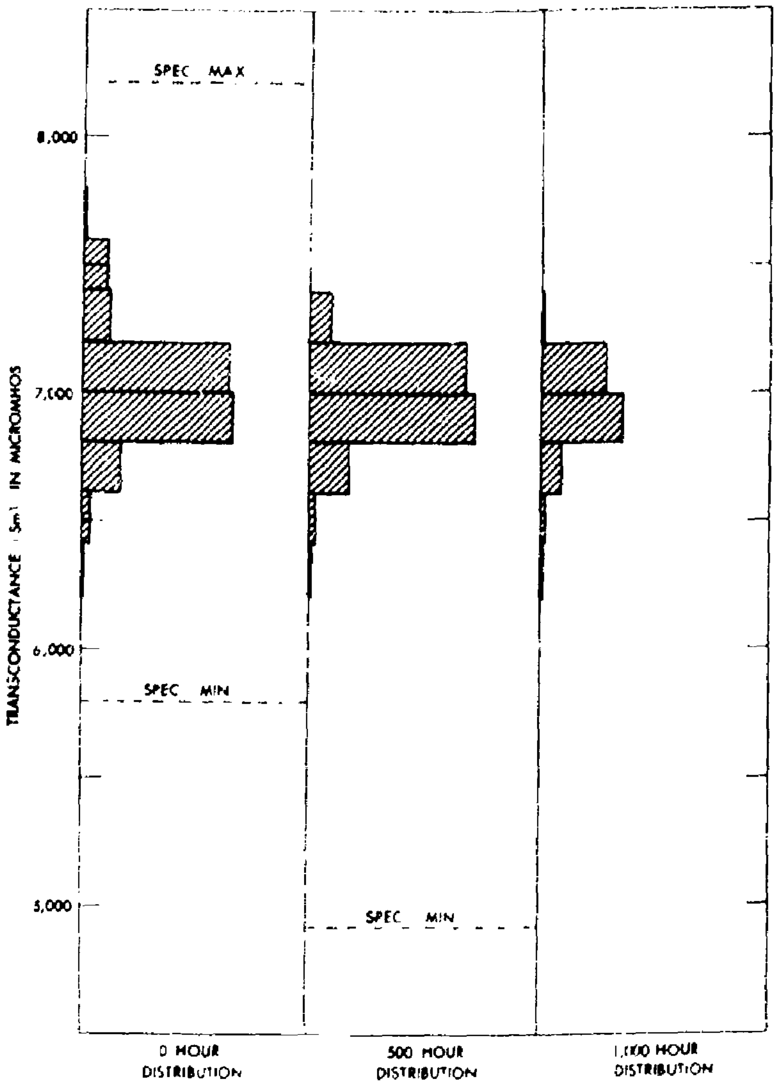


Figure 4-38. Distribution of Transconductance for JAN-6080WA

4.22.2 The distribution curves below are based upon 380 tubes life-tested by one manufacturer of the type during the period of January 1955 through October 1955. The specification limits shown are taken from MIL-E-1/510B dated 5 December 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

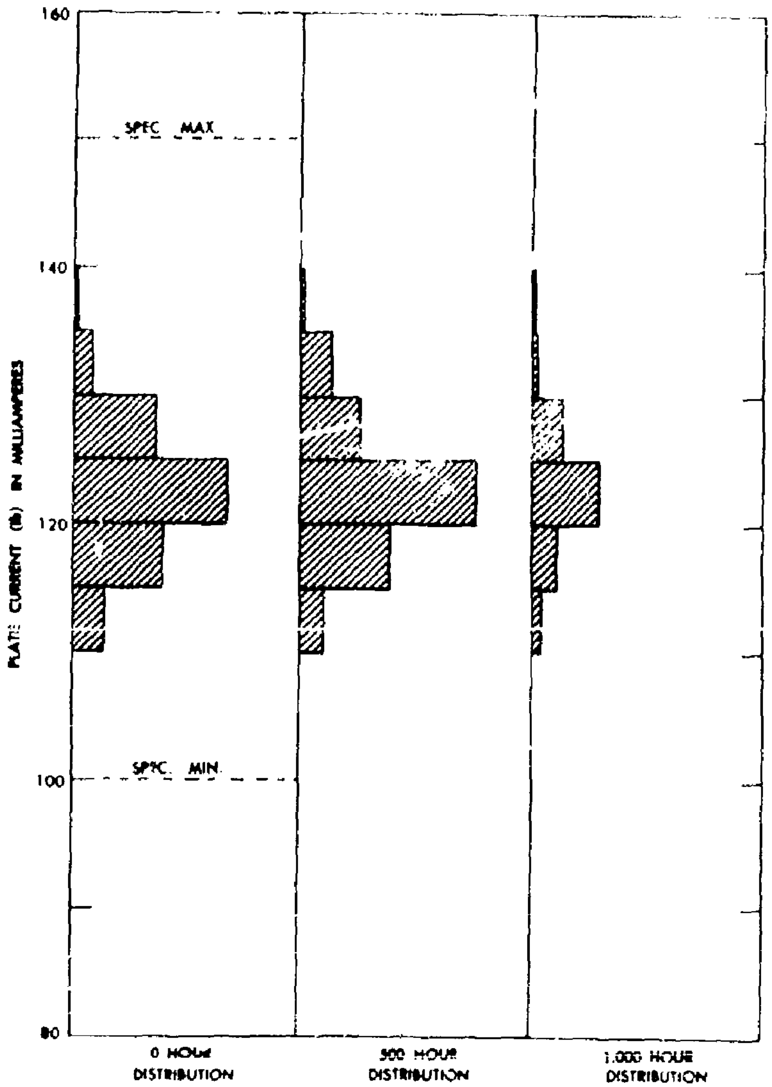


Figure 4-39. Distribution of Plate Current for JAN-6080WA

SECTION 23

PROPERTY BEHAVIOR FOR JAN-6112

4.23 DISTRIBUTION CURVES.

4.23.1 The distribution curves below are based upon 718 tubes (18 lots) life-tested by one manufacturer of the type during the year 1955. The specification limits shown are taken from MIL-E-1/190B dated 5 August 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

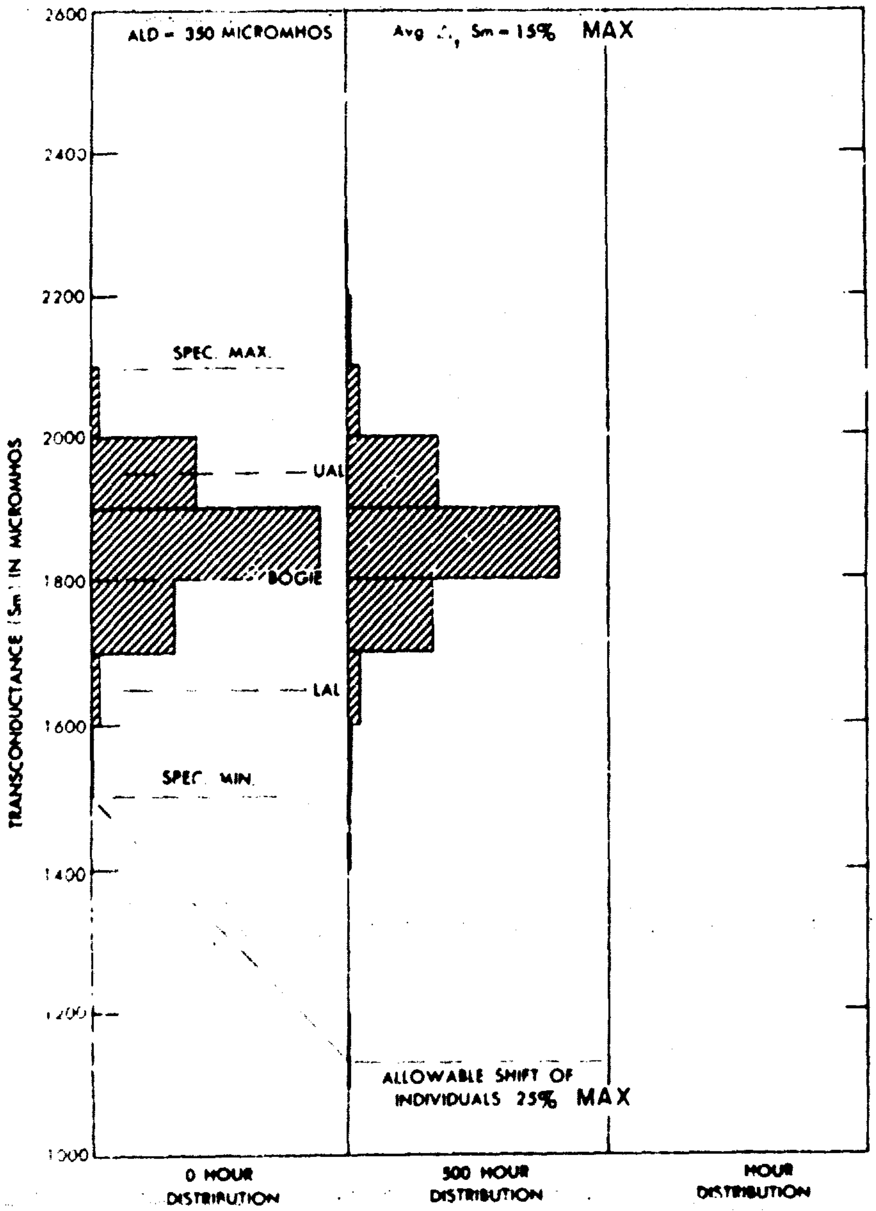


Figure 4-40. Distribution of Transconductance for JAN-6112

4.23.2 The distribution curves below are based upon 718 tubes (18 lots) life-tested by one manufacturer of the type during the year 1955. The specification limits shown are taken from MIL-E-1/190B dated 5 August 1955. Only data from lots accepted by the specification is used. Each distribution curve includes data from all tubes still operative at the time associated with that curve.

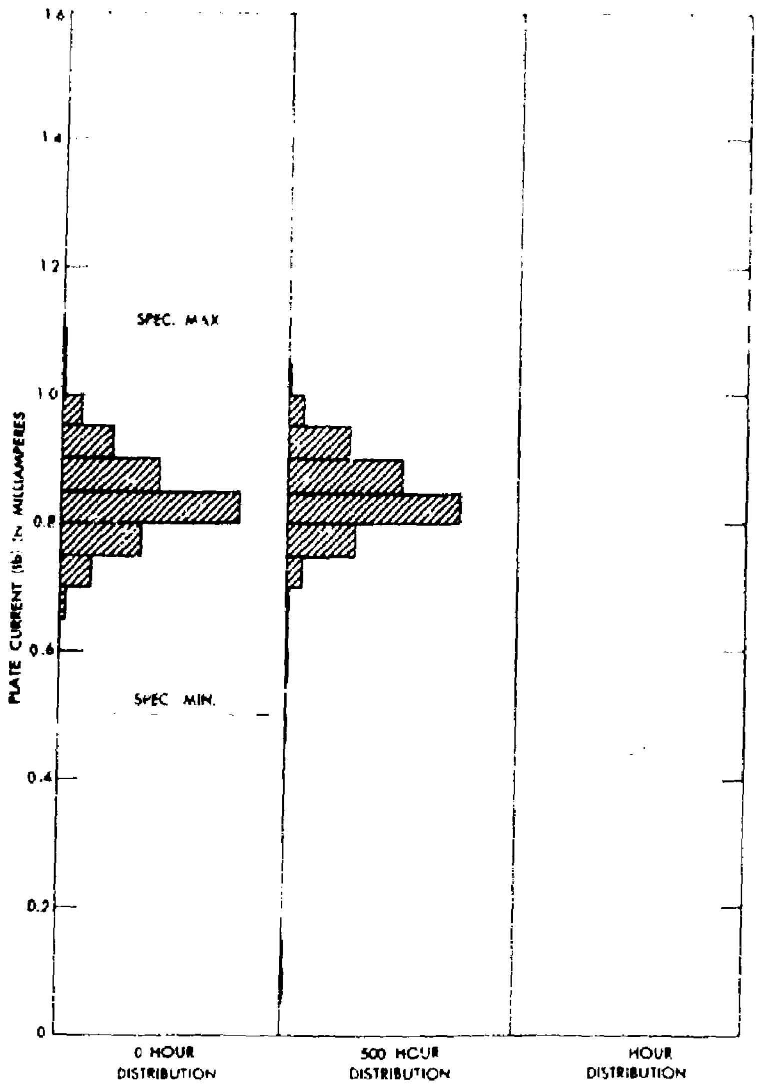


Figure 4-41. Distribution of Plate Current for JAN-6112